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The AUTOMOBILE

Tungsten—The Hardener

Resists Heat and Retains Magnetism—Valuable for High-Speed Tools, Valves, Lamp Filaments and Magnets—Can Be Drawn to .0002 Inch Diameter

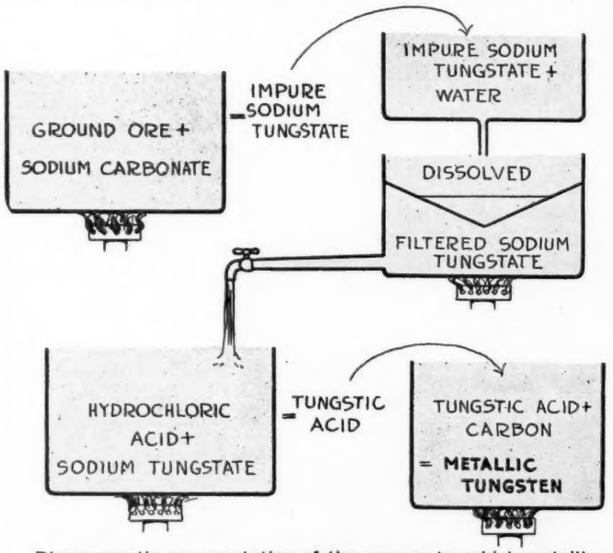
By J. Edward Schipper

TUNGSTEN has three qualities that have rendered it of high value to the automobile and other industries. It is a great hardening element, it is a resister of heat and it increases the retentivity of magnets. These, with the many other qualifications, render this element one of our most important alloying substances.

Tungsten was once classed among the tin ores and in its mineral form was known as heavy stone, due to its great weight. Next to platinum, iridium and gold it is the heaviest metal, having a specific gravity of 17.3 as compared to 11.3 for lead, 7.85 for steel, 22.3 for iridium and 19.2 for gold. A cubic foot of tungsten weighs 1,078.7 pounds. A cubic foot of iridium, the heaviest metal, weighs 1,396 pounds. A cubic foot of gold weighs 1,200.9 pounds and a cubic foot of lead weighs 709.7 pounds.

In 1781 Scheele proved that a tungsten ore was composed of lime, combined with a peculiar acid and 2 years later Spanish chemists succeeded in producing metallic tungsten. The mineral tungsten or the ores containing the element are principally found in the form of what are known as Wolframite, after its discoverer, Wolfram; and Scheelite after its discoverer Scheele. The Wolframite is chemically known as a tungstate of iron and manganese, and Scheelite is a calcium tungstate.

Tungsten is a great hardener of steels. By incorporating simultaneously carbon and tungsten it is possible to obtain a much harder steel than with carbon alone and at the same time eliminate the danger of increasing the brittleness to a dangerous extent. This is the element which was perhaps unconsciously, incorporated in the famous oriental Damascus steel, the making of which was at one time classed as a lost art. It is one of the elements of what is known as high-speed steel.

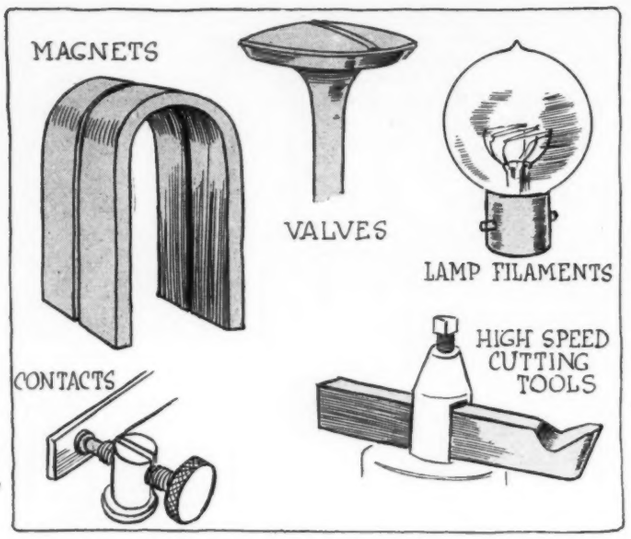


Diagrammatic representation of the process by which metallic tungsten is derived from Wolframite, the ore in which it is most commonly found

Tungsten is a metallic element and, when used in conjunction with the elements chromium and carbon it raises the temperature to which steel can be brought without losing hardness. This quality makes it of use where high-speed cutting is desired because the heat due to cutting does not soften the edge of the tool until it has reached a much higher temperature than with the ordinary tool steels. A typical composition of a chrome-tungsten or high-speed steel is carbon .68 to .67 per cent. manganese .07 to .11, chromium 5.95 to 5.47, tungsten 17.81 to 18.19. Many variations of this formula are used for tools for different purposes.

Often Alloyed with Cobalt

In producing a cutting metal tungsten is often alloyed with cobalt. Ellwood Haynes, who is known in the automobile industry as a pioneer car builder, has marketed a non-ferrous



Some of the articles which are made from either metallic tungsten or steel alloyed with tungsten

metal which he has termed stellite, a combination of tungsten and cobalt with other alloys in which the only iron present is an impurity and in which the iron is therefore kept to the lowest possible percentage. Thus, although the name is somewhat deceptive, it is not a steel.

Another field in which tungsten has been of great use in the automobile industry is for the manufacture of poppet valves. Here the same qualifications, namely, those of heat resistance and hardness, have rendered it of great use in eliminating, to a large degree, the necessity of grinding. The effect which tungsten has in rendering steel free from the influences of heat at ordinary temperature may be guessed when it is known that tungsten is not fusible in a common forge. Chromium possesses this same quality and both these metals, instead of melting at forge heat merely soften. The melting point of tungsten is 3,002 degrees.

A feature that makes tungsten of great use for magnetos is that when added to a magnet steel in a ratio of from 5 to 8 per cent. it increases the retentivity of the magnet to a great degree. For instance, in magneto work it is possible to charge the magnets to more than 100 per cent. complete saturation and then after the charging circuit has been removed these magnets will drop to but slightly below 100 per cent., saturation and retain this great degree of magnetism for a remarkable length of time.

Can Be Drawn Into Fine Wire

One of the most spectacular achievements with tungsten is the success which has been attained in rendering it ductile. By super-refining the metal with secret methods, the big electric companies have succeeded in rendering a metal which is harder than glass, so ductile that it can be drawn into wire of less than .0002-inch in diameter. This wire can be used for lamp filaments up to considerably more than 2,000 candlepower. While millions of tungsten filament lamps are used in households throughout the world resulting in a saving of hundreds of millions of dollars a year by using only approximately half the current consumed by the carbon filament lamp, filaments do not take up a very large percentage of the total tungsten output. It is stated that 1 pound of tungsten will produce the filaments necessary for 40,000 electric bulbs of the size commonly used for household purposes, or the ordinary 25-watt size.

Besides the uses which have been mentioned, tungsten is one of the important factors in electric furnace work, it is often employed for the manufacture of surgical wire, for use as targets in Roentgen tubes, for weights and it has even been suggested as a good material for the jackets on rifle bullets due to its heat-resisting and non-stripping qualities.

Tungsten Ore Scattered Over Earth

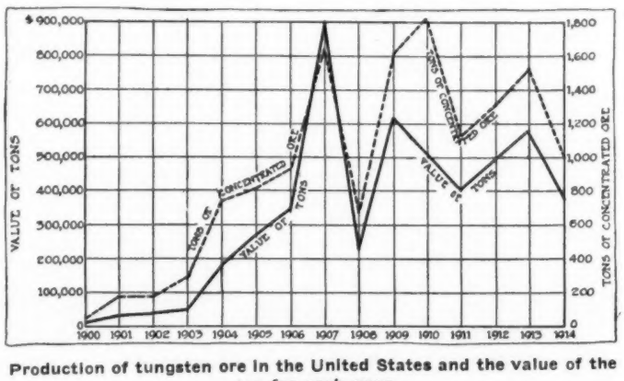
While tungsten ore is found practically in all parts of the world, it is stated that its mining is so hazardous commercially that it would not pay any company to specialize on this ore. Considerable pockets may be found and mined and give rise to optimistic hopes in the mind of the mine-owner only to be shattered by finding that when the end of the pocket has been reached there will be no more tungsten ore in sight. Hence it is that the tungsten ore is more or less of a mining by-product. When the prospectors hit upon it they are glad to mine it taking what they find and treating it more as a prospector's than a miner's enterprise.

Some of the countries which have been most productive of tungsten ore during the last 10 years are Japan, New South Wales, Queensland, England, France, Germany, Portugal, Argentine Republic, United States, South Africa and Burma. The accompanying tabulation shows the production in short tons of each of these countries between the years of 1905 and 1912. The curve on page 353 shows the number of tons of concentrated tungsten ore produced in the United States between the years of 1912 and 1914, with the value of these ores. The treacherous nature of the ore deposit can be readily seen from the quick yearly fluctuation in the amounts produced by these different countries. This is instanced by the case of Burma which did not produce any until 1910, when 407 tons were mined. Two years later the production was 2,095 tons, the largest recorded in any country up to that year. The production in the United States started with 46 tons in 1900 having a value of $11,040, gradually increasing up to the year 1910, when the value was $832,992. This represented a production of 1,821 tons. The tons referred to are short tons of 2,000 pounds and the ore is concentrated and contains 60 per cent. of tungsten trioxide.

High-Speed Steel Created Demand

The use of high-speed tool steel which took a quick rise in 1912 caused a corresponding jump in the demand for tungsten. It was also responsible for the introduction of the use of cobalt. The demand for the metal was so great that in addition to our own supply in 1 year 323 short tons of tungsten valued at $323,872 and 824 tons of ore in miscellaneous forms were imported. Wolframite and Scheelite were the principal components of the ore imports. Considerable interest was aroused in 1913 by the discovery of deposits of a tungsten ore known as Ferberite in the boulder fields of Colorado and during this year 953 tons of concentrated ore were removed from these fields. This was more than half the production of the entire United States which totaled 1,537 tons for that year.

While the tungsten deposits have been unreliable there



Production of tungsten ore in the United States and the value of the ore for each year

has always been enough produced throughout the world to meet the demands, and consequently there has been no sharp rise of price except for a momentary panic at the time of the outbreak of war. The 1914 price as quoted by one authority was $6.50 to $9 per unit, or 1 per cent. of 1 ton, that is, 20 pounds. A further idea of the value of the ore may be gained by the fact that during 1914 a total of 267 tons valued at $139,697 were imported and during 1913, imports were 401 tons, valued at $213,122. This would give a value of $523 per ton for the imported ore in 1914 and $532 in 1913. The imports of the metallic tungsten for 1914 and 1913 respectively were 192 tons and 661 tons. The values of these were $219,506 and $835,212. This would give a valuation on the metal of $1,142 for 1914 and $1,262 for 1913.

Extraction by Threefold Method

The metallic tungsten can be abstracted from the ore by a three-fold chemical reduction process. The first stage is to secure sodium tungstate by heating together a mixture of the ground ore and sodium carbonate in a reverberatory furnace. When this operation is carried out under proper conditions the extraction is complete and at the same time any silica present is left insoluble. The sodium tungstate thus formed is dissolved in water and separated from the oxide of iron, aluminum, manganese, tin and silicon by filtration. From the filtered tungstate, tungstic acid is then precipitated by adding another acid.

The tungstic acid is washed free of soda salts and dried, and the resulting tungstic oxide is mixed with carbonaceous materials and submitted to a high temperature in crucibles for a reduction to metal. This is the method used by the fathers of tungsten refining, Oaxland, 1847 and Mushet, 1859. This process is known as the Oaxland process and is said to be the basis of that now used, although the manufacturers of tungsten guard the secrets of their individual methods with great care.

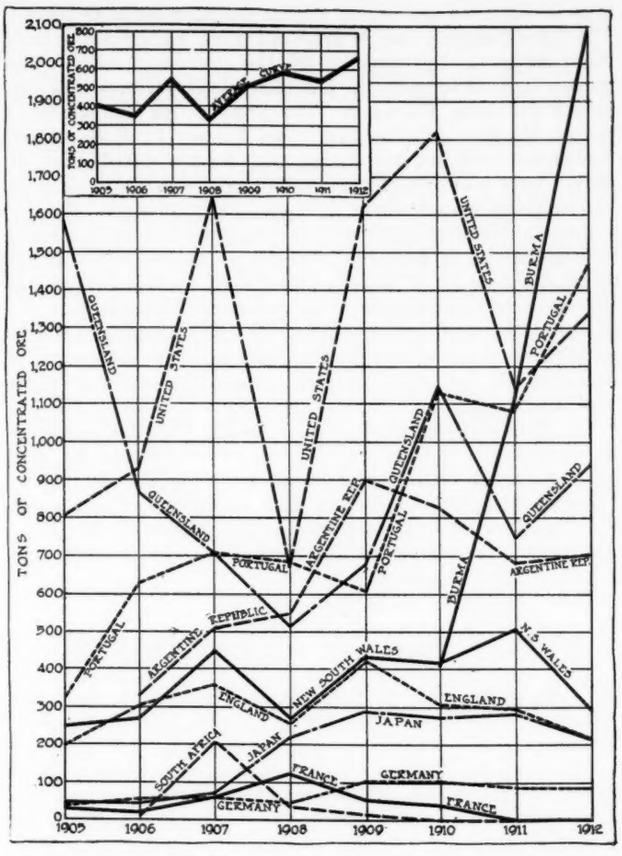
Generally Sold as a Powder

Metallic tungsten is generally sold in powdered form, but a considerable quantity of ferro-tungsten or tungsten with iron is manufactured with the electric furnace and alloys with manganese and other metals can be obtained by reducing a mixture of the oxides with aluminum. In 1903 it was stated that the purest forms of tungsten at that time obtainable were not ductile but since this time the work of scientists has been rewarded wih the results that are so clearly shown in the use of the tungsten lamp filament. The tungsten powder as sold to the steel makers consists of about 98 per cent. tungsten, .5 per cent. iron, .5 per cent. silicon, and .5 per cent. carbon. It is stated that 100 parts of tungsten can be obtained from 127 parts of good Wolframite and it is estimated that it

Tungsten Ore Production to 1913 by Different Countries

Country	1905	1906	1907	1908	1909	1910	1911	1912
Japan	47	47	71	220	292	275	287	215
N. S. Wales	251	270	451	269	431	413	512	298
Queensland	1,582	865	703	516	679	1,145	750	944
England	193	304	361	261	421	307	298	216
France	28	20	67	124	55	33	0	0
Germany	42	57	68	46	106	105	89	89
Portugal	320	629	702	684	609	1,132	1,078	1,466
U. S	803	928	1,640	671	1,619	1,821	1,139	1,330
Argentine	....	326	507	548	900	826	683	702
South Africa	....	9	211	40	16	0	0	0
Burma	....	....	....	....	....	407	1,119	2,093

Sold in units of 20 pounds, 1 per cent. of a short ton



Production of tungsten in the leading countries of the world, showing the rapid fluctuation due to the ore being found in pockets and not generally in long veins. Note the sensational rise of the production in Burma. Note average curve at upper left

costs $400 to refine 1 ton of ore. The method by which the selling price of the tungsten is arrived at can very readily be estimated from the fact that ore can be bought at about $450 per ton and since the refining costs $400 with allowances for shipping and other overhead the selling price will be somewhat over $1,000, as previously estimated.

Ductile tungsten is a bright, tough steel-colored metal. Its physical characteristics are unique in that the tensile strength will vary materially per unit of cross sectional area with the amount to which it is drawn. Tungsten wire .0012-inch in diameter will have a tensile strength carrying from 580,000 to 610,000 pounds per square inch. Steel piano wire has a tensile strength of 340,000 pounds per square inch. It is stated that with the tungsten tool steel the amount by which the work done can be increased sometimes runs as high as five times that which can be accomplished with carbon steel. This will of course vary to such an extent that no figure can be fixed but that the cutting speeds have been greatly increased due to the introduction of high-speed tool steel is the principal reason for the adoption of the tungsten alloy.

Steel That Resisted Blowpipe

An interesting example of what may be done with tungsten is furnished by a steel alloyed with this metal which was exhibited by Dr. Carl Duisberg at the Eighth International Congress of Applied Chemistry. This steel resisted the flame of an oxy-acetylene blow-pipe. The exact composition of this has been kept a secret.

The form in which the steel manufacturers secure the tungsten for use as an alloy varies with the class of steel for which it is intended. For the lower grades ferro-tungsten

is used while for the higher grades the pure metal is bought. The ferro-tungsten can be produced much more cheaply than the pure metal by reduction in the electric furnace. The purest form of tungsten in practical use is perhaps that employed for lamp filaments. The process for manufacture gained its first definite step when Turner D. Bottome, an American, took out his patent No. 401,120 dated April 9, 1889. This was one of the original processes for producing the tungsten wire filament.

Some authorities state that the tungsten filament is not a pure metal as is tantalum, but is, in the majority of instances, a filament of minute particles of metal sintered into coherence by the passage of an electrical current after the filament has been squirted and dried. For all practical purposes, however, the filament of a tungsten lamp is generally considered as an example of the highest refinement of tungsten metal.

It might be thought that owing to the fact that tungsten does not melt until above 3,000 degrees it would be difficult to alloy it with other metals owing to the dangers of burning these before amalgamation took place. This is not the case, however, as tungsten has the quality of dissolving in other molten metals, thus rendering the process of mixing the alloy quite simple. It is estimated that 95 per cent. of the tungsten produced is so used, being consumed by the steel manufacturers throughout the world. The Sheffield Steel Works in England are said to use 1,500 tons of tungsten powder annually. This is a value of $1,650,000 if the value per ton be taken as $1,100.

High Speeds Bring Out Value

While the great value of tungsten or high-speed steel for cutting tools cannot be doubted, it is a fact that these steels do not have a value until high cutting speeds are reached. Experiments which have been made in England have shown that every tool that has yet been tested without the use of a cooling agent has very little durability at the lowest cutting speeds and a much greater durability at higher speeds. For instance, at 20 feet per minute every tool tested was rapidly worn away. Another rather unexpected result which was arrived at from the same series of tests is that at low speeds a carbon steel tool properly hardened has greater durability than the best high speed steel. At high speeds great durability is shown by high speed steels properly hardened, and it is claimed that some of the vanadium tool steels show this to a high degree.

War Sends Up Price of Manganese

NEW YORK Feb. 24—Considerable concern is being felt in steel centers over the fluctuation in the prices of ferro-manganese. This is due to the fact that about half the manganese used in this country for alloying is imported from Great Britain and Germany. Owing to the embargo on this alloy established by the former country, and the difficulties in shipping from the latter, the supply has been curtailed to almost the entire extent of the importation.

A nominal price is now being quoted as $68 per ton for ferro-manganese at the seaboard, that is, Baltimore or Boston. This does not represent, however, the true prices that are being paid as sales at $100 per ton are frequently reported. Before the war broke out the price of ferro-manganese was $38 per ton.

The remaining 50 per cent. of the manganese used in this country is made by the Carnegie Steel Co. and this concern uses practically all that it manufactures, hence very little can be secured from the Carnegie company for outside use. Now that the German blockade against England has been declared, it is feared that the shipments which were previously finding their way to this country at scattered intervals will be checked altogether.

Bought as Ferro-Manganese

The ferro-manganese as received by the purchaser consists of about 80 per cent. manganese and nearly 20 per cent. iron, the remainder being silicon and other impurities. Its use in ordinary steel work is of a medicinal nature. Manganese when taken alone decreases rather than increases the general merit of the steel to which it is added. It shows its effect principally in reducing the malleability but it is added intentionally in quantities as high as 1.5 per cent. to palliate the effect of sulphur and oxygen.

With sulphur, it forms a sulphide which draws together into almost harmless drops, instead of incasing the grains of iron and thereby weakening the structure of the metal as sulphur would alone. With oxygen it forms a manganous oxide which is less harmful to the general structure of the metal than would be the ferrous oxide that would be present were not the manganese added. As actually made manganese steel is said by most authorities to contain about 1.2 per cent. of manganese and 1.5 per cent. carbon. According to S. A. E. specifications ordinary carbon steel averages between .50 and .80 manganese. The preferred percentage of manganese generally ranges very close to .65. The defects of the manganese steel such as Hadfield's for general use, are its hardness and low elastic limit.

Manganese is a metallic chemical element. At one time it was taken to be a magnetic oxide of iron but in 1740 J. H. Pott showed that it did not contain iron and in 1774 C. Scheele proved that it was the oxide of a distinct metal. The metal was first isolated by J. G. Gahn in 1774. It is part of the atmosphere of the sun and is found in sea water and in many mineral waters. Commercially it finds its biggest use in the manufacture of special steel.

Corrects Effects of Impurities

Spiegeleisen, in which form the manganese is generally added to the steel to correct the effects of the sulphur and oxygen impurities and to counteract the hardening influence of silicon is a combination of iron with from 10 to 30 per cent. manganese. Spiegeleisen generally contains about 5 per cent. carbon. It is the shortage of spiegeleisen which in turn means a shortage of manganese that would most bother the steel makers in case they were not able to secure an adequate supply.

Manganese steel is used for such purposes as parts of crushing machinery and similar machines where great strength combined with hardness and resistance to wear are demanded. The well known Hadfield's manganese steel contains about 13 per cent. of manganese and 1 per cent. of carbon. It is very strong, tough and hard and is used generally in a cast condition. It is somewhat softened by quenching from a yellow heat, and is hardened again by reheating and allowing it to cool slowly. The reason that it is used in the cast condition is that it is exceedingly difficult, and, in fact, practically impossible to machine.

Vail Is Rutenber General Manager

MARION, IND., Feb. 22—R. A. Vail has been made vice-president and general manager, S. R. Chenoweth, treasurer, and P. A. Watson, director of the Rutenber Motor Co., this city. These changes were made necessary owing to the retirement of R. O. Berger from the office of vice-president and director and of J. W. Stephenson as treasurer and general manager. J. W. Stephenson retains his interests in the company and his membership in the board of directors.

Omaha—Distributor for the Grain Belt

$16,026,750 Worth of Cars, Trucks and Accessories Sold in 1914—Bright Prospects for Coming Year

By David Beecroft

OMAHA, NEB., Feb. 20—Last year Omaha distributors and dealers in automobiles and accessories sold $16,026,750 worth of merchandise through the Omaha territory, a good round sum for this city with a population of 200,000 made up by counting in Council Bluffs and such other suburbs as Benson, South Omaha, Florence and Dundee.

Omaha is not seriously considered by many as a car distributing center in comparison with Minneapolis, Kansas City or Dallas, yet figures speak eloquently in proving this to be a center of proud proportions, a city that lies nestled in the heart of the grain belt and a city whose motor jobbing business of slightly over $16,000,000 per annum compares favorably with Kansas City, whose annual jobbing trade reaches $39,000,000.

Spend a few hours with Omaha car dealers and finish up with half a day at the Commercial club in this city and you will be started on the road to conviction that Omaha is being heard from and will make a louder noise in the future.

Omaha's Importance

Omaha ranks as the third live stock and packing center of the country, being led only by Chicago and Kansas City.

Omaha is the fourth primary grain market in the United States and is second as a corn market.

Omaha leads all other cities as the greatest dairy city in the country.

Omaha has one of the largest gold and silver smelters in the land.

Last, but not least, the annual grain report shows that the State of Nebraska stands fifth in total value of crops for 1914. The figures are:

COMPARATIVE CROP VALUES

State	Crop Value
Iowa	$351,450,000
Illinois	319,656,000
Texas	290,335,000
Kansas	287,662,000
Nebraska	210,099,000
Missouri	192,981,000
Minnesota	180,432,000
South Dakota	106,488,000

Is there any reason why the proud citizens of Omaha, during last week when the automobile show held the boards at the auditorium, should not laud the value of this city in the retail automobile field? For 10 consecutive years the show has been held in the same hall and under the same management. Clarke F. Powell, of the Powell Supply Co., managed the first show and still wears the crown of perennial management. The first show had six exhibitors but this week there were forty-five, thirty-three showing passenger cars on the main floor and twelve others exhibiting commercial vehicles in the basement. Fifty different makes of passenger cars were shown and sixteen makes of motor trucks. There were no accessories.

Omaha holds a closed show. You must be a bona-fide dealer, located in this city and with a real salesroom and a legitimate leasehold before you can get on the exhibition floor. This is due to the constitution of the Omaha Automobile Show Assn., a $50,000 corporation which sells stock at $50 per share to bona fide dealers. One share of stock entitles you to exhibit privileges. Forty dealers are members and all were in the show this week. Manager Powell says that not in 10 years of Omaha show history has more than one of the members of the association been absent from the show. Outsider makers were here this week trying to pick up last-minute space, but they found the bars up. No salesroom, no space, is the cast-iron rule of the show. Here the outsider who would like to wait till the show week to launch his cars before the public, is not welcome, but let him take up his residence here, open his show room, conduct a real business and at once he becomes part and parcel of the show organization.

Like Minneapolis and Kansas City, the Omaha show is largely a dealers' show. There are over 4,000 automobile dealers in this territory, and of these almost 2,000 registered. A year ago 1,400 attended. Next year we may look for 3,000. Many of the dealers attending this week brought two or three prospects with them. Some paid their railway fares, others did not. Many of these dealers closed two or more sales before closing hour tonight.

Great Potential Buying Power

Locally the 200,000 population of Greater Omaha is a potential buying power and many retail sales were closed during the week. This is not the opportune time for retail sales. It is a little early, November, December, January and February being the dead months for delivery. Deliveries start March 1, almost a month earlier than Minneapolis, and continue until the end of October.

Before endeavoring to analyze the Omaha selling field it is necessary to appreciate the territory served by this city. This territory embraces the entire State of Nebraska, the western tier of counties in Iowa, and with some dealers the lower half of South Dakota. This is an agricultural zone of no mean proportions. It aggregates a total area of 100,000 square miles, all the best farming land of the country. This area is one-half greater than all of New England. It is double the area of New York State. You could place a dozen New Jerseys in this zone. It is a little greater than Illinois and Indiana combined.

The potential buying ability of this zone is appreciated when you recall that Nebraska stands fifth as a grain-producing state, that Iowa is first, and that one-quarter of Iowa comes in the Omaha zone.

Pause and analyze the crop status of Nebraska for the past year, bearing in mind the high grain prices now prevailing and also the fact that the surplus crop money is largely going to be spent for automobiles and farm implements. Last year the Nebraska wheat crop was 142 per cent. normal, or 42 per cent. above the average crop for the last 5 years.

The oat crop was 130 per cent. of the 5-year average; corn was below normal, being only 82 per cent. of the average for the last 5 years; alfalfa was 130 per cent.; and hay fell below the 5-year average being a 90 per cent. crop. Here are the figures:

1914 NEBRASKA GRAIN CROPS

	Average Crop 5 Years, Bushels	1914 Crop, Bushels	Per Cent
Wheat	49,079,400	69,732,953	142
Alfalfa	1,973,820	2,689,613	136
Oats	54,836,200	71,413,531	136
Corn	183,201,200	150,235,060	82
Hay	*5,544,749	*3,015,575	90

*Tons.

These figures only have meaning when the increase for 1914 is seen. For 1915 prospects are even brighter. The state has been well clothed in snow, the ideal condition for wheat; the crop acreage is larger than ever before and a banner

year for 1915 is already fairly well assured. Prices are sure to be high, even if the war came to an unexpected end.

Grain Buys Cars

If the farmer were not the big buyer of cars it would be useless to quote crop figures such as these, but this is the granary of the world and if you would get your finger on the pulse of industry then get your mind firmly fixed on the crop situation. A. A. Murphy, president of the Murphy-O'Brien Automobile Co., distributor of Paige and Dodge cars, says his concern will sell two-thirds of its output to farmers. G. L. Dingman, sales manager of Stewart-Toozer Motor Co., selling Chalmers and Pierce cars, says the company sells 10 per cent. of its machines in Greater Omaha and the remaining 90 per cent. go to his majesty, the farmer. The farmer sales are well assisted by the fact that there are strong banks in the small towns in Nebraska as well as western Iowa, so that sales are largely cash, the banks arranging for any accommodations that the farmer may require.

J. R. Jamison, local Overland distributor, has a small territory, twenty-six counties in northern Nebraska and four counties in South Dakota, yet a week ago he had a trainload of Overlands arrive, thirty-two freight cars carrying 126 machines. This was the first time such a trainload of Overlands had reached this city. Mr. Jamison got the territory last autumn, yet seventy of these cars were sent direct into the territory and the other fifty-six into storage in this city. Mr. Jamison has already twenty-eight dealers, by May he hopes for forty, and he spends practically all of his time going through the territory.

For the last 10 years the automobile jobbing business has been growing very steadily, not only in Nebraska but in western Iowa and the lower part of South Dakota. Figures compiled by the Commercial Club of Omaha covering the last 3 years shed interesting light on this growth. Since 1912 the jobbing in cars and accessories has almost doubled, rising from an annual total of $9,598,750 in that year to $16,026,750 the present year. Statistics for the 3 years are:

OMAHA'S JOBBING BUSINESS

	1912	1913	1914
Cars	$7,289,976	$10,891,158	$12,358,558
Accessories	2,308,744	2,284,500	3,668,192
Totals	$9,598,750	$13,175,658	$16,026,750

The increase from year to year is regular rather than spasmodic, and the 1914 figures are encouraging in spite of the war, which had its effect for 30 days in August until the citizens found that farming, dairy, and meat packing were to continue, war or no war.

A Big Accessory Center

Omaha is a big accessory distributing center, there being approximately eight supply houses that have considerable wholesale and retail business. Manager Powell, of the Powell Supply Co., was not only a pioneer in the car selling field in Omaha but also a pioneer in the exclusive accessory business. Today his supply house trade is 98 per cent. wholesale and 2 per cent. retail. But the accessory business growth has not been so consistent as the car business, in fact, 1913 fell a little behind 1912 but the gain in 1914 was most substantial over 1913. The drop in 1913 was largely due to cars, particularly the cheaper makes, being sold with complete equipment, a fact which reduced the accessory field, and makes the showing for 1914 more important.

Few Closed Cars and Electrics

Omaha is a poor city for electric passenger cars, and as such stands in strong contrast to Kansas City where the electric is strong. The Omaha citizen cites the hills as being a great reason for few electrics, particularly as the best residential section is all along the hills. Kansas City has its hills but it also has the electrics. Other reasons have been advanced why the electric has not made greater strides here, one being that this city is not a great manufacturing one in the sense that Toledo, Indianapolis and other eastern cities are, and that there is not the money. Another is that the zone of travel here is greater than in an eastern city of the same population, and the limitations of the electric are apparent. The fact remains that Omaha is not as yet a strong closed-car center, the gasoline coupé not being a big seller, and naturally the closed electrics are wanting.

As a dealers' show Omaha does not rank as high as Minneapolis and Kansas City, but this week has long been looked for by the local distributor and also the out-of-town dealer. The dealer comes to the show. There are over twenty Chalmers dealers in the territory and all were here. The "Hup" is represented by over sixty, nearly all of whom were present, and during the week many new ones signed up. The same is true of Overland, Dodge and a host of other makes.

Jitneys Promote Interest in Automobiles

NEW YORK CITY, Feb. 24—Reports of growing jitney activity and the rapid spread of the movement for 5-cent automobile fares throughout the country continue. Ohio and Illinois towns have taken up the idea, which means greatly increased popularity for the automobile, and Milwaukee has a $100,000 jitney company. Recent developments are:

COLUMBUS, O., Feb. 19—The jitney bus idea is rapidly spreading in the Buckeye State. Steps have been taken in at least four cities of Ohio to operate jitney buses on a more or less organized plan and outside of Columbus the movement has apparently met with considerable success.

The first city to start the buses was Cincinnati, where the "Jitney Mobile Bus Line Company" was organized. Several lines were first established and passengers were numerous. Later on the promoters extended their operations to other lines, and at present about a dozen routes are being covered.

In Cleveland the idea became so strong that President John J. Stanley, of the Cleveland Railway Company, the traction system of that city, started a counter movement to operate 3-cent buses in competition with the jitneyists. Mr. Stanley claimed that his company was preparing to transfer from the buses to the traction cars, and vice versa. Three competing lines declared their work a great success, claiming that each bus should clear $12 a day.

In Columbus the idea spread like wild fire when Promoter William O'Hara announced the formation of a partnership. Before O'Hara could get his buses in operation a number of individuals started lines, mostly from the center of the downtown section to the east and the west corporation lines.

In Toledo the idea was very successful. There is a fight against the traction system in that city, because of the expiration of the franchise, and many of the people took to the jitney buses in order to register a kick against the traction system. In all more than 50 cars are being operated in that city.

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MILWAUKEE, WIS., Feb. 23—Although the jitney bus made its appearance in Milwaukee several weeks ago, it was not until Monday, February 22, that the latest public transit idea was firmly and definitely established here. The Milwaukee Jitney Bus Co., capitalized at $100,000, was incorporated on Monday and on Tuesday morning started business with thirty five- and seven-passenger cars, running on a strict schedule and over certain routes.

The new corporation was organized by C. A. Van Ess, who formerly was secretary of the Chicago, Peoria and Quincy traction line. E. A. Perkins is president and treasurer; Louis Rother, secretary, and Mr. Van Ess general manager of the new line. The offices are at 209 Second street, between Grand avenue and Wells street. Busses will be operated on five crosstown streets.

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BLOOMINGTON, ILL., Feb. 20—The jitney bus idea has reached Bloomington, Peoria, Decatur and other central Illinois cities, but it is doubtful if it will be permanent, the business not being large enough to warrant the purchase of special cars. Automobiles holding five to seven passengers are temporarily in use. The street railway company managers are watching the performance of the new competition but say that it is not serious enough to warrant any action.

Making the Spiral Bevel Gear

How Its Action Differs from Ordinary Bevel Gearing and How the Cutting Operation Is Performed

EXPRESSED in a few words, the object of the spiral bevelgear is to spread over several teeth in partial contact the load that, in a plain bevel, would be all upon one tooth, and to provide teeth that do not engage over the whole length of tooth at once, thereby lessening the shock as tooth meets tooth. The fundamental basis of the bevel gear is the cone, which means that if the axes of two shafts when produced intersect at a point it is always possible to find a pair of cones that will roll together perfectly when mounted upon the respective shafts, and the points of the cones will always coincide with the intersection point of the shafts. Now, in forming an ordinary bevel gear the teeth are partly cut out of the surfaces of the theoretical basic cones, and partly built up on the cones, so the center line of each tooth may be regarded as being a line drawn on the surface of a cone. Imagine the two cones rolling together in frictional contact, and suppose we draw a line on one of them. If this line were made with some glutinous matter, we should find on turning the cones that the line was reproduced on the surface of the other cone quite sharply; there would be no smudging, because the cone surfaces roll over each other and have no sliding.

Layout of Curved Teeth

Now, in the ordinary bevel gear approximately half the depth of the tooth is *above* the surface of the base cone, so if we were to plane away the top half of a tooth we should be able to regard the two sharp edges of the remaining portion as two lines drawn upon the surface of the theoretical base cone. Since the same applies to the other member of the bevel gear combination it is easy to see that lines drawn lengthwise along the middle of the face of each tooth in the pinion will meet squarely against corresponding lines drawn on the teeth of the large gear. Returning now to the idea of the base cones, it is easy to see that the shape of the line drawn on one does not matter, any sort of a pattern drawn on the pinion cone will be reproduced upon the large cone. If we draw straight lines from apex to base they will reproduce lines of like character on the other member and the reproduction will be instantaneous for the whole length of the line, but if we draw the line slantwise across the surface, or if we make it curved, only one *point* on the line can be in contact with the surface of the other cone at any instant. The extreme case is, of course, a circle drawn round the small cone parallel to the base circle.

It is not necessary to go into the theory of gear tooth formation, to describe the complicated processes whereby the surfaces of the teeth are calculated so that every point on one tooth makes square contact with the opposite tooth without allowing any sliding or slipping. Assuming that the teeth are so formed it remains obvious that a straight tooth makes contact over its whole length at once just as the straight line drawn from apex to base of the base cone reproduces its whole length at one instant. If, however, we cut a curved or slanting tooth on the cones their point of contact will pass along their length from one end to the other just as the curved line on the base cone reproduces itself little by little on the other cone.

It is obvious that there ought to be less shock if we can arrange a number of curved teeth to replace an equivalent number of straight teeth, because while the load is traveling along the length of one tooth the next will be coming into action and the previous one will be nearing the end of its contact path. It is usual to proportion the size of gears and the dimensions of their teeth so that the tops of one pair are in contact at the same instant as the bottoms of another and the center portions of a third pair, but this distributes the load over several teeth by virtue of the shape of the teeth themselves, while the use of curved teeth distributes the load on account of the shape of the base line around which the tooth is built up, *as well as* by virtue of the tooth form.

It is practically impossible to design any gear so that all the tooth surfaces roll over each other without sliding, at all events such a gear could not be made by any manufacturing process, but the ordinary gear approximates fairly to the theoretical ideal. For cutting bevel gearing in particular the process known as generation gives the best results because it uses a tool that has merely to be ground to a plain straight edge and not in any sort of curve or tooth formation. To use such a straight cutting edge for the production of gear teeth, the blank from which the gear is to be formed has to be rotated slightly on its axis as cutting proceeds, or the carriage bearing the tool can be swung while the work remains stationary. In cutting curved teeth for spiral bevel making it is necessary to move both cutter and work because we have two curves to cut, that of the center line of the tooth and that of the tooth surface; the latter is, of course, at right angles to the former.

Advantages of Spiral Bevels

Before turning to details of the machine evolved for cutting the spiral bevel gear some remarks may be made as to its efficiency and its points of advantage and disadvantage. It is not to be expected that the efficiency is quite so high as in a plain bevel, because the thrusts are heavier, but it is not likely that this extra friction is in the least serious, and the advantage of quietness in operation is ample to compensate for it. Also it is a fact that there is not the same need to adjust the pinion and gear ring so accurately as is required to get reasonably quiet running from a plain bevel, though the efficiency of the spiral bevel must be at its best when the meshing of the teeth is in accordance with the theoretical pitch cone diameters, since with gears of any kind, deviation from proper meshing introduces irregularities in the rolling action of the teeth.

Caring for Thrust

The thrust that has to be resisted by the bearings supporting a spiral bevel is far greater than that of a plain bevel because the teeth of the former make an angle with the center line of the shaft on which the gear is mounted, instead of being parallel thereto. There is always thrust on bevel gears because of the natural tendency for one to roll away from, or out of mesh with, the other; just as there is a separating thrust between two shafts connected by ordinary spur gearing. The extra thrust due to the spiral teeth corresponds exactly to the endways thrust which appears on spur gear shafts when helical teeth are substituted for plain ones. The Gleason company have made a series of tests of plain bevel gearing and spiral bevels of different angles which show that

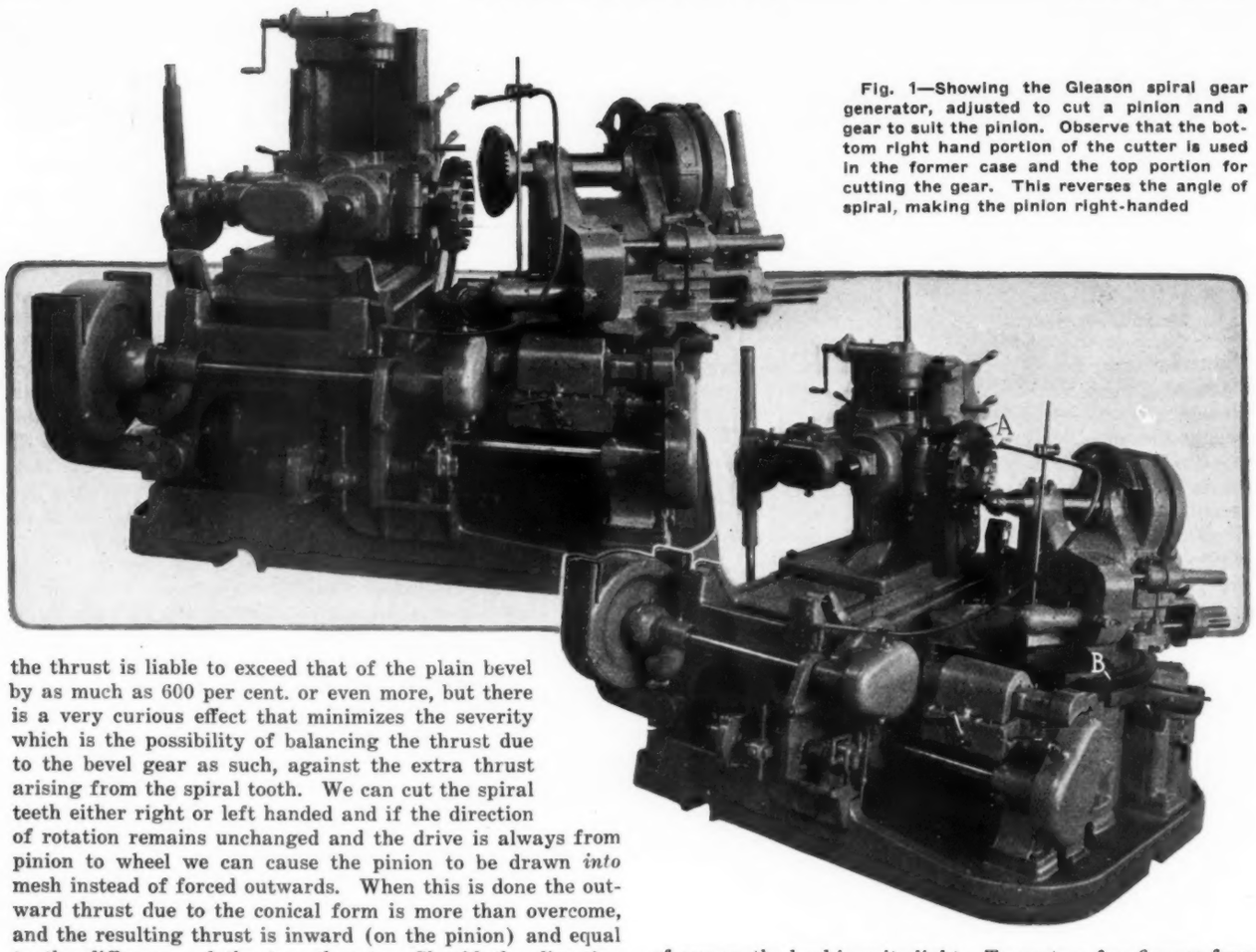

Fig. 1—Showing the Gleason spiral gear generator, adjusted to cut a pinion and a gear to suit the pinion. Observe that the bottom right hand portion of the cutter is used in the former case and the top portion for cutting the gear. This reverses the angle of spiral, making the pinion right-handed

the thrust is liable to exceed that of the plain bevel by as much as 600 per cent. or even more, but there is a very curious effect that minimizes the severity which is the possibility of balancing the thrust due to the bevel gear as such, against the extra thrust arising from the spiral tooth. We can cut the spiral teeth either right or left handed and if the direction of rotation remains unchanged and the drive is always from pinion to wheel we can cause the pinion to be drawn *into* mesh instead of forced outwards. When this is done the outward thrust due to the conical form is more than overcome, and the resulting thrust is inward (on the pinion) and equal to the difference of the two thrusts. Should the direction of rotation be reversed the two thrusts are added together and will act outward, so for automobile work it is customary, though not essential, if large thrust bearings are used, to cut the spiral in a direction which will cause it to draw the pinion inward during forward running under engine power, and only force it outward on reversing or on occasions when the car drives the gear by inertia, as in coasting and then, of course, the load is quite light. To quote a few figures from the thrust determinations made in the Gleason works the plain bevel showed an average thrust of 7.3 per cent. of the tooth load, a spiral bevel of 19 degree angle an inward thrust of 28.7 per cent and another spiral bevel of 31 degree angle had an inward thrust of no less than 49.5 per cent. the tooth load. These thrusts are quite capable of efficient handling by ball thrust bearings or roller thrusts of sufficient size, but their magnitude shows that bearing troubles may be expected if spiral gears are merely substituted for plain ones in an otherwise unchanged axle. A point which can be made in favor of the spiral bevel and which has not received quite the attention it deserves, is that it is suitable to greater gear reductions than the plain type, because of the way in which the tooth curvature spreads the load over a number of teeth and removes the shock of contact. Also the pinion is not weakened by undercutting to the same extent as it would be if made plain and of equally small diameter.

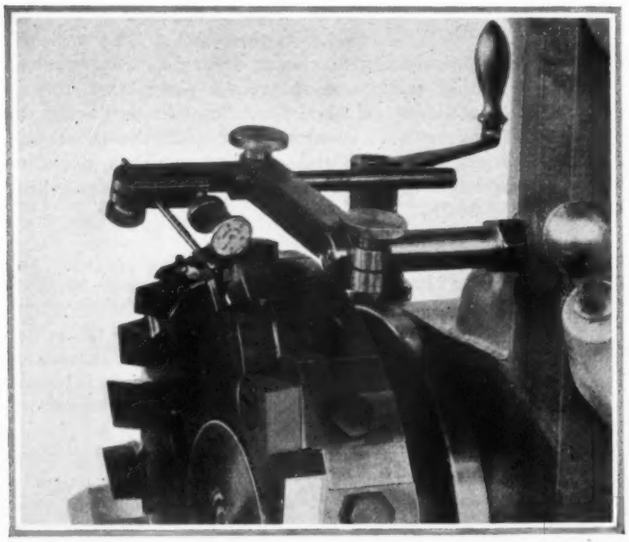

Fig. 3—Testing the circularity of the inserted tooth cutters by micrometer gauge reading to less than a ten-thousandth of an inch

Cutting the Spiral Bevel

The machine that has made the spiral bevel a commercial possibility has been developed by the Gleason Works of Rochester, N. Y., during the past couple of years. All the best machines for cutting plain bevels work on the generating principle, in which the blank being cut and the tool that does the cutting are made to roll during the operation, just as though they were two gears in mesh. This rolling being controlled by master gearing causes the tool to cut a perfect tooth form out of the blank. All generating gear cutting machines are somewhat complicated, but the Gleason spiral bevel cutter is only a little more so than ordinarily while it has the quality of operating almost as rapidly as the plain type bevel machines. In the latter the cutter used is almost

always straight sided, all the curvature of the tooth face being produced by the rolling of the carriages holding the tool and the work, and the cutter is caused to reciprocate back and forth in a straight line. Obviously a straight line reciprocation cannot produce the curved tooth needed for the spiral bevel, so the Gleason machine has a revolving cutter head with multiple cutters, and this produces a tooth curved to the same radius as the radius of the cutter head.

Regulating the Cutter

It follows that if we regard the cutter as revolving on a fixed center, the tooth produced will make different angles with the axis of the pinion or wheel being cut according to whether the work is raised or lowered with respect to the cutter. This means that we can lay a series of curved teeth around a bevel blank either almost parallel to the axis (like slightly bent straight teeth) or at a sharp angle, the angle being measured from a tangent taken across the middle point of the tooth. Turning now to Fig. 1, A is the revolving cutter seen at work on a pinion. The pinion is mounted on a mandrel which is set in rigid bearings on a carriage which can be turned round in a horizontal plane by the rack shown. This adjustment is to suit pinions and wheels of different cone angles and has to be altered when the nature of the work is changed.

Determining the Angle of Tooth

Standing at the right end of the machine shown in Fig. 1 and looking squarely at the cutter it would be obvious that we should need to move the cutter either horizontally, vertically or both to get it to cut any desired angle across the face of the pinion. If we think of the cutter as a clock face and adjust it till the pinion blank touches the cutter ring at a position corresponding to 22½ minutes past the hour the tooth angle would be roughly 45 degrees. In the illustration as shown the pinion is being cut with a right hand spiral, but if we moved the cutter to bring the pinion to 7½ minutes past, that is the corresponding point on the upper half of the cutter circle, then the angle would be the same but the cutter would make a left hand spiral instead of a right hand. Since a wheel has to be cut of opposite hand to a pinion it is always necessary to adjust the cutter to the exact relative position when changing over from one to another. These

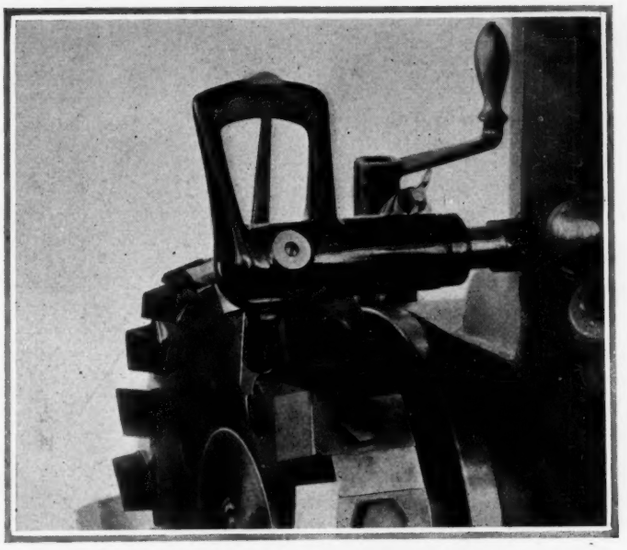

Fig. 4—Testing the distance of the cutter points from the head of the machine. This adjustment is to ensure the cutters being all in one vertical plane so as to give each an equal depth of cut

vertical and horizontal settings of the cutter head must needs be extremely accurate, since the angle of the teeth and the proper relationship between pinion and gear depends entirely upon them. The vertical lifting screw for the cutter head can be seen in Fig. 1 and there is a scale at the back reading in even inches. Just in front of the handle at the left top of Fig. 1 the fine circular scale is seen, this reading in thousandths. There is a corresponding transverse slide which can be seen in Fig. 2 and this is equally delicate. So far we have the cutter head capable of sliding up and down vertically on a base that can itself be moved transversely on a second bed, and this second portion is semicircular and can rock to and fro on vees of which the ends are seen in Fig. 1, and a side view given in Fig. 2. Behind the blank being cut at the rear end of its mandrel are gears through which the mandrel can either be rocked or revolved and these gears are interconnected with those that give the rocking motion to the whole cutter carriage.

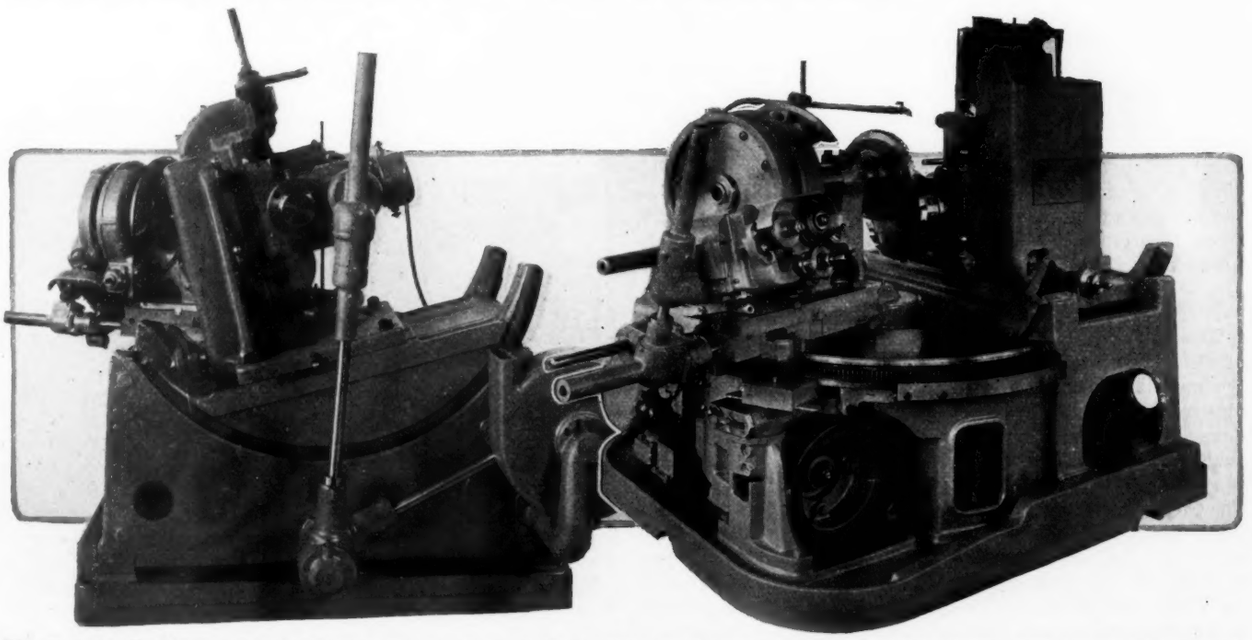

Fig. 2—Left—End view showing guides and V bed on which cuttter head rocks. Right—Showing driving gear for oscillating work mandrel and indexing

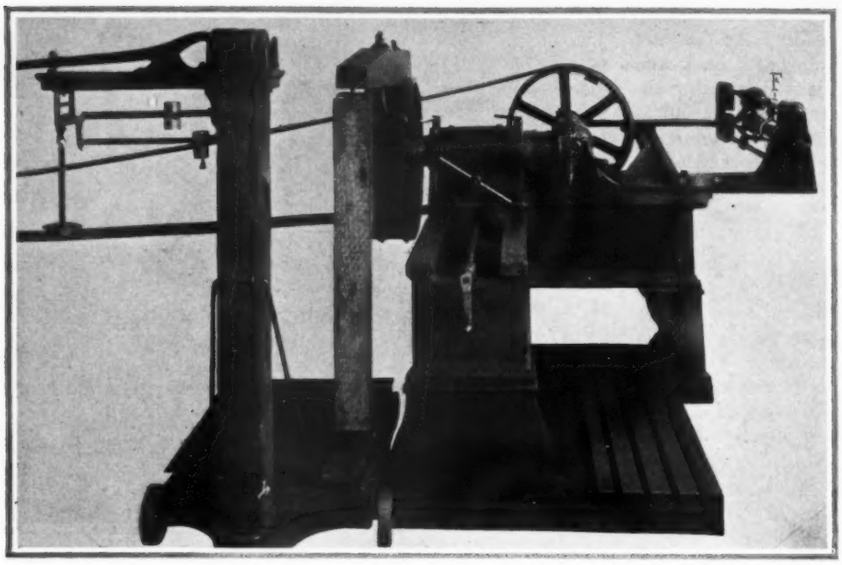

Fig. 5—Machine used to test thrust of spiral bevel and plain bevel gears. The pinion is held up to the gear by a sliding thrust collar, itself supported by the arm seen in the background. This arm terminates at the fork F, which is located between two calibrated springs, so that thrust can be read when pinion is adjusted into proper mesh

The cutter begins to operate on the blank at one end and, as it cuts, the blank is rolled slowly, causing the metal to be removed so as to leave a perfect tooth face on one side and a partially finished face on the other side of the groove. Meanwhile the cutter carriage rolls slowly also and this causes the cutting point to travel lengthwise along the blank, so continuing the groove right across the entire face of the blank.

Operation of Reversing Mechanism

As soon as one cut is completed a reversing mechanism comes into action turning the cutter carriage back to its original place. The work is swung away from the cutter in the horizontal plane, and the gears which roll the work mandrel index is ready for the next cut; whereupon the whole process is repeated. When the teeth are all finished on one side the opposite faces are dealt with and the cutters are staggered so that every other blade registers with the next but one; if there are twenty cutters ten operate on the outside and ten on the inside, doing opposite sides of the teeth. This introduces a slight inaccuracy, since the diameter outside the cutters is a little greater than inside them, and one tooth face is cut to a slightly sharper curvature than the other face. The effect is to cause the gears to mesh a little more tightly at the middles of the teeth than at the ends, but the deviation from theoretical form is possibly even an advantage in practice.

Making Adjustments for Roll

The adjustments for different degrees of roll to suit gears of differing sizes is made by a series of change wheels and the machine is sent out equipped with combinations to suit any ordinary styles or dimensions. There is only one fundamental setting that requires great care and this is the adjustment of the blades of the cutter. These blades are separate pieces and are ground upon a special machine in the Gleason works, but they require to be kept in an absolutely true circle. For testing this circularity the little gauge shown in Fig. 3 is employed, it being mounted on a peg screwed into the head and capable of reading to less than a ten thousandth of an inch. There are little wedges beneath each cutter blade and they enable the adjustment of any blade to be made rapidly and with high accuracy.

There is another important dimension of the cutter and this is the position of the tops of the blades, since the plane in which these lie must always contain the vertical axis about which the work carriage is swung. Another gauge, shown in Fig. 4, is used to check this adjustment, and to move the cutter back and forth there is a very fine setting for the bearing which supports it and this is equally as easy to handle as the other gauge.

Once the machine has been adjusted to suit the work in hand its operation is automatic, or nearly so, and there are so many facile adjustments that it is easy to correlate the roll of work and carriage. All change gears that need to be got at in the process of setting up are in accessible places and the lubrication is exceedingly thorough; the vee slides are supplied with oil under fair pressure from a pump. Thus there is nothing in the work that cannot easily be mastered by any mechanic accustomed to gear cutting, which means that the manufacture of bevel gears of spiral type can be undertaken by automobile plants far more readily than the cutting of worm gearing.

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Detroit Tries Out Traffic Signal

DETROIT, MICH., Feb. 20—To further improve traffic conditions here a new device invented by secretary of police Walters is being tried out on Woodward avenue, where traffic is most intense. It consists of a 7-foot metal post on top of which are mounted two metal cross pieces, one painted red, the other green, the former having painted on it in white letters the word Stop, and the latter the word Go, also in white. A handle placed at a convenient reach for the traffic officer in charge of the post permits him to turn the sign in whatever direction he desires, for either stopping traffic or having cars move on. At night the post is surmounted with a red light. The device will be tried out several weeks before it will be decided whether it is to become a permanent feature for the regulation of traffic.

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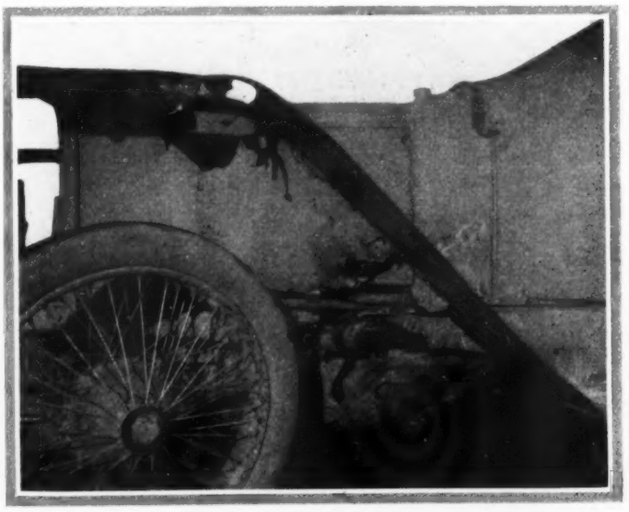
Results of a Trip to the Firing Line



The effect of a shell which dropped on the fender of a car in the Argonne district, one of the battlefields of the Allies and Germans

Horizontal Shocks with Cantilever Springs and Flame-Welded Clips

(The Improvement of Spring Systems—VIII)

By M. C. K.

IN politics a letter to or from a friend—a private letter intended for publication—has often served conveniently to place on record an opinion or statement of facts which had been previously less aptly or correctly expressed. Such a letter has been received with regard to the means which might be adopted in order to take up horizontal shocks in connection with the use of cantilever springs. It explains itself, as such letters always do, and reads:

My dear M. C. K.—With the seventh of your series on Spring Systems just at hand, I feel that I should enter a mildly protesting disclaimer with regard to one of the sketches you have made to illustrate the provisional conclusions which we reached at our recent discussion of ways and means for introducing a horizontal cushioning effect in motor vehicles without interfering materially with standard design. I can do so with a sense of perfect freedom, as you know that I am in substantial agreement with your views on the ultimate necessity of this improvement for the commercial vehicles, if they are to run at more than 8 miles per hour over the humps and potholes of our crude thoroughfares, and of its desirability for all automobiles in view of tire economy and safety for the vehicle springs and passengers at high speeds. I refer to Fig. 18—which by some accident has been captioned Fig. 19 under the illustration—representing a cantilever spring hung from a pivoting clip which, as your text says, "is simply longer than usual and formed below the spring with a suitable abutment R for the thrust rod." This is scarcely in accordance with our conclusion; neither does it agree with your subhead to the effect that "combination springs are impossible." With all allowance for the omission of detail that is acceptable with mere diagrams, I am bound to look upon a spring made in conformity with this sketch and description as a "combination spring"; that is, one in which the vertical and the horizontal components of a shock are cushioned by the same spring elements without a distribution proportionate to their severity. You have explained why this ordinarily cannot be done satisfactorily, the fundamental reason being that vertical shocks are determined by the axle load and the horizontal ones by the weight of the whole vehicle and that, precisely when the shock is most severe and dangerous, the combined force of the two components must tax a combination spring beyond its capacity if it is adapted for the light work of cushioning the milder shocks in which the vertical component predominates. Let me attempt to express this in more concrete terms, using your own figures: "You cannot cushion 8,524 footpounds of horizontal stress in a 1 to 2 inch movement of the same spring combination from which you expect to use a 4 to 5 inch movement for cushioning 3,180 footpounds of vertical stress. That is, the two actions will be of very unequal efficacy."

Now, the spring arrangement outlined in Fig. 18, under Fig. 17, does permit vertical shocks to be cushioned by the cantilever spring alone, if they come entirely without complication with horizontal shock, but this is a rare instance. If there is a complication, on the other hand, the vertical action is plainly increased by the rearward axle movement, since this involves an additional pivotal movement of the cantilever spring. If the horizontal shock predominates, the situation is in my opinion worse. The receding of the axle is then necessarily accompanied by a sharp upward movement for which there is no use, and the front end of the cantilever spring is stressed correspondingly, while the movement of the thrust rod is unduly limited by these implicated resistances.

It is quite evident to me, after our discussion of the whole subject, that the construction shown must have slipped into print by inadvertence, as it is so contrary to the trend of your reasoning at all other points. I venture to offer you a corrected sketch, which represents, I believe, what we really had in mind, differing from the first Fig. 18 only by having an additional pivotal action which separates the vertical and the horizontal cushioning actions almost completely. Even so the construction suggested cannot be termed more than experimental. In wishing to substitute this sketch for the previous one, I have another object in mind, in which I know that you heartily concur. I refer to the effect which publication of this sketch may have to forestall another one of those numerous patents for obvious improvements—or obvious possibilities for improvement—which really should not belong to any individual or corporation, as they represent merely normal and unavoidable ideas in a development belonging to the industry at large and would crop out in one individual if they did not in another. We all know, however, that patents of this character, "copped" from the common fund of thought-material, are so much more obstructive of general progress as they are more obvious and therefore in lesser degree the moral property of the patentee.

Along this line of ideas, I sketch the clip in the corrected Fig. 18 on the supposition that a progressive and possibly patentable idea has also been incorporated in this detail. It is represented as produced by casting, forging or stamping, in the latter case with the aid of autogenous welding of the piece F, and this process is also used for the assembling with the spring. The accompanying notes will enable you to make the suggestion clear.

I dare say you are willing to induce your readers to linger a little longer on this whole subject of horizontal springing which so far has met with such scant and hesitating recognition of its importance, and I will therefore add one word about the front spring, Fig. 21. This is also a combination spring, frankly so, and must be a little hard for the shocks in

(*Continued on page* 389)

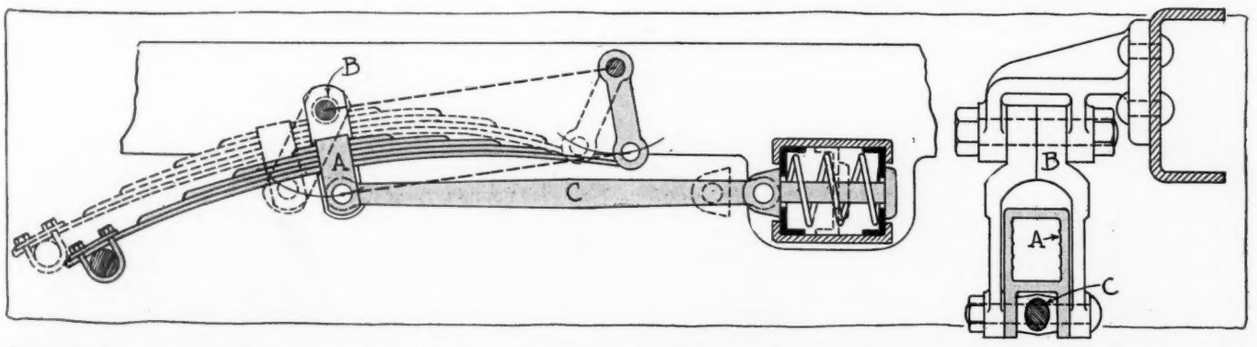


Fig. 18A (Corrected)—Cantilever spring working in conjunction with end-thrust spring without being influenced by the latter. Front shackle plates omitted. Further improvement: Place big shackle under tension, instead of compression, by reversing it

Light Pistons Make Smooth Motor

Reducing Piston Weight Increases Power, Lessens Vibration and Improves Durability of Motor

By Eric W. Walford

ALL reciprocating engines suffer from the disadvantage that the pistons have each to be stopped and restarted twice in every crankshaft revolution. Their direction of travel is changed at each dead center, so the inertia of the piston mass has to be overcome four times each revolution, since effort is required to start it moving either up or down and then to stop it moving at the other end of the stroke. It requires no mathematics to make clear that the lighter the piston the less the effort needed to move it or to arrest its motion, or to put it the other way round, if we have a definite power for starting or stopping the piston then the lighter it is the faster will it accelerate and the more quickly come to rest.

Thus reducing the weight of the pistons of a four-cylinder motor:

1. Reduces the jerk caused by reversing the motion at the dead point and so lessens vibration.
2. Decreases the stress on the crank bearings and connecting-rods.
3. By reason of 1 and 2 permits increased motor speed and so increased power.

Methods for Reducing Piston Weight

There are three ways of reducing piston weight; we can design with great care and machine more accurately so as to make the best possible use of good cast iron, we can substitute steel, or we can even use aluminum alloy. Each method has advantages and corresponding drawbacks which will be treated presently. Meanwhile it suffices to say that iron and steel are costly to machine with sufficient delicacy, steel is more liable to suffer from high temperature than iron, while aluminum is almost ideal providing that the metallurgists can give us an alloy which does not become brittle after long use. There is a kind of solidity about the light piston made from aluminum that is very attractive and this cannot be found in any construction of steel or cast iron.

Turning back to the three advantages tabulated above, a conclusive way of proving that they are correct would be to drive, through electric motors, two gasoline engines which are identical except that one possesses pistons which are half the weight of those in the other engine. At equal speeds of revolution the difference in vibration would be quite noticeable, and this would be particularly true at high speeds. In course of time, as the speed increased, trouble would be experienced with the connecting-rod bearings of the heavy-piston engine or, if the speed were increased rapidly to a high figure, it is very probable that one or more of the connecting-rods would break, while at the same speed the engine with the light pistons would not suffer. If the electric current consumed could be measured, it would be found that the light-piston engine would take less power to drive at high engine speeds than the engine with the heavy pistons; which means, conversely, that by reducing the piston weights the power is increased.

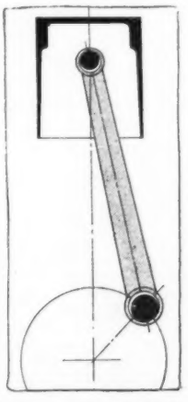


Fig. 1—Showing how bearing pressure is reversed on upstroke

Reduction of the weight of the pistons diminishes the vibration at all engine speeds, and one has but to make a substantial change in the weight of the pistons of a known car in order to appreciate the improvement. Recently the writer substituted built-up steel pistons for the original cast-iron set, saving almost half the piston weight. The effect was most pleasing and made it easy to understand why there is such a marked tendency amongst European manufacturers to reduce piston weights.

Effect on Speed

It is natural to associate light pistons with racing car engines and it is therefore assumed that their advantage is greatest at very high speeds, which is correct, but it must be borne in mind that the value of light pistons is only to be found at high speeds; there is no fixed engine speed above which it is essential to have light pistons, and below which no advantage accrues from their use. Those who urge that a reciprocating piston is a form of flywheel overlook the all-important inertia stresses which cause so much worry to designers of high-speed engines. English manufacturers who are building engines for very small cars, have experienced much trouble through failure of the connecting-rod bearings, because purchasers of these cars make use of the high speed capabilities of their motors; and many racing car designers consider that it is the connecting-rod bearing pressures that place a limit upon engine speeds. At one time the limiting factor was the inability to fill the engine cylinders; now the chief difficulty is to keep a film of oil between the connecting-rod bearing surfaces. This can, of course, be overcome by the employment of high pressure forced lubrication where the oil is taken direct to the connecting rod bearings through a drilled crankshaft, but there is a limit to the effectiveness of this way of tackling the difficulty.

Demonstrating Actual Stresses

The reduction of stress on the connecting-rod and its bearings by reducing the piston weight can best be demonstrated by an example. We will assume that a piston weighs 2 pounds and that it has a stroke of 6 inches. At 1,000 r.p.m. the maximum velocity reached will be about 33 feet per second, and the energy stored in a 2-pound piston at this speed is 34 foot-pounds, while the motive force necessary is 137 pounds and this represents the stress on the connecting-rod due to inertia. At 2,000 r.p.m. the figure is 548 pounds and at 3,000 r.p.m., it is 1,233 pounds. If the pistons weighed 3 pounds each the figures would be 210 pounds, 840 pounds and 1,890 pounds, respectively. It is clear, therefore, that, in order to reduce the stress on the connecting rod, the load on the connecting-rod bearings and the side thrust of the pistons on the cylinder walls, it is extremely important to cut down the piston weights. Side thrust is of great importance in slide-valve engines as it causes binding pressure on the sleeves. By

reducing piston weight the connecting-rods can be made lighter, so that the reciprocating weights can be reduced still further, but it would obviously be fatal to lighten the rods and leave the pistons heavy.

From the foregoing it becomes clear why heavy pistons are detrimental to the life of a motor and how light pistons lessen the possibility of connecting-rod or bearing troubles.

Reversal of Load

We have seen that a rising piston moves faster and faster during the first half of the upstroke and then slows down again as the crank comes toward the top. If the motor is running fast there may be energy enough started up in the piston by the time it reaches the half way position actually to more than overcome the compression pressure of the gas above the piston. When this speed is reached the load on the connecting-rod bearings changes over suddenly, at half stroke, putting the load on the underside of the crankpin where it will remain for a quarter revolution before the firing stroke, or for half a revolution if the suction stroke is following at its upper side. After passing a half stroke, the piston slows down and the pressure on the wristpin and crankpin is transmitted to the other sides of these bearings. Obviously, the heavier the piston and the greater the speed of revolution, the greater would be the pressure on the connecting-rod bearing arising in this way from the inertia of the piston. Assuming that the bearings are designed to deal with a certain load due to the explosion, it is clearly possible to ruin these bearings by subjecting them to far greater pressures which may arise easily solely from the inertia of the pistons. As stated, the lighter the pistons the smaller will be the stresses due to inertia; or to put it the other way, the higher will be the engine speed before these stresses become serious. By reducing these stresses by lightening the pistons, bearing friction is reduced and there is therefore more power available. Consequently, by using light pistons, not only is the maximum power put up owing to the possibility of increased engine speeds, but at anything above moderate speeds, the power is increased because the friction is lessened.

It may be of interest to mention that many makers of very high speed engines find that the crankpins wear chiefly on the inner and not on the outer side. The explosion pressure comes on the outer side of the crankpin, but the chief inertia loads come on the inner side and that this is the part that wears out most quickly shows the importance of reducing the load due to inertia as much as possible.

Steel and Aluminum Pistons

The steel piston is easy to make strong and light if the expense of machining it is not considered, but this is so much greater than cast iron that one can say that steel pistons are almost out of the question for moderate priced cars. Also there is the disadvantage that steel pistons sometimes fail in the head because the extremely thin metal that is strong enough to bear the explosion is not able to carry away the heat to the cylinder walls fast enough. In racing car engines the failure of a steel piston through the head becoming red hot and blowing out is not uncommon. To overcome this the Sunbeam company devised a piston with a central leg, or strut, which was machined so as just to touch the middle of the wristpin. This gave support and also carried heat away, the pin being sufficiently massive to transfer the heat to the water-cooled cylinder walls with sufficient rapidity. This piston has been used in racing with complete success, but it is very expensive to make. Several light pistons are shown in Fig. 2.

Aluminum has the outstanding advantage that it is cheaper to machine than any other metal and a light piston has still to be thick enough to remove the delicacy from the machine operations. Its drawback is that it seems liable to become brittle under the action of continued heat, eventually reaching a crumbling stage when it blows out or gives way at the wristpin supports. Still aluminum alloy pistons have been used with great success on some high-powered motors, and it appears that the secret of success lies with the alloy makers. This is most encouraging because it suggests that a little more experiment may very probably indeed result in the discovery of an alloy that will be everything required.

At present the easiest thing to do is to be prepared to spend a little money on making a motor smoother in running and to reduce the weight of cast iron pistons by using good iron, designing so that every portion of the piston does its share of the work—so that there is no dead metal—and machining with accuracy.

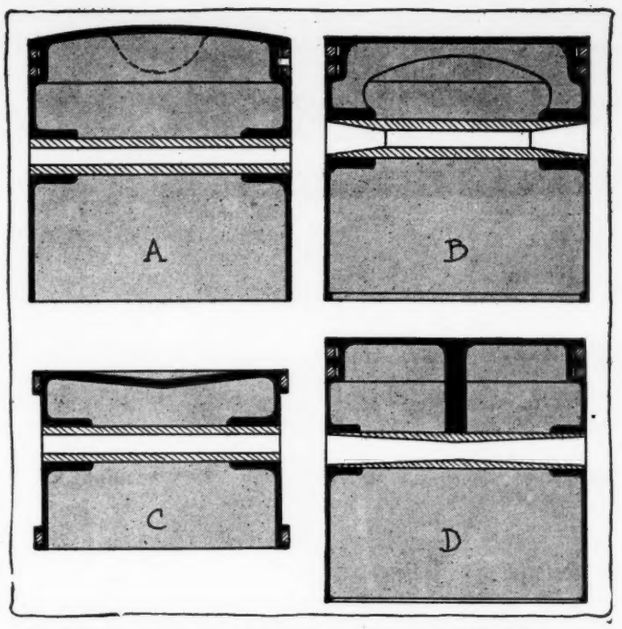


Fig. 2—A—Pressed steel piston with parts welded together by oxy-acetylene. B—Successful light cast iron piston used for aeroplane engine. C—Steel piston machined from solid bar with cylinder contact on piston rings only. D—Sunbeam design of piston machined from bar with central support for head

INERTIA STRESSES FOR PISTONS OF 2 AND 3 POUNDS WEIGHT

	2-pound piston	3-pound piston
1,000 r. p. m.	137 pounds	210 pounds
2,000 r. p. m.	548 pounds	840 pounds
3,000 r. p. m.	1,233 pounds	1,890 pounds

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RACINE, WIS., Feb. 20—To meet the demand for instruction in Spanish occasioned by the inability of stenographers and correspondents in Racine manufacturing plants to cope with the South American mail now coming in, the Racine board of education has instituted a course in this language in connection with the evening high school courses conducted each winter. The initial enrollment in the Spanish course was eighty-two and has now reached more than 100. The Case, Mitchell-Lewis, and L. P. C. automobile companies and numerous other large factories in Racine are developing an extensive trade with South American nations and it has been found necessary to import correspondents and stenographers from large cities to handle the mail.

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CLEVELAND, O., Feb. 20—The National Carbon Co., this city, has received a request from Borghoff, Santos & Co., Rio de Janeiro, Brazil, which states that they are very desirous of receiving propositions from manufacturers of all automobile accessories, tools and waterproof canvas, accompanied by prices, discounts, terms, and samples.

The Engineers' Forum

Piston Ring Problems—Faults and Advantages of Various Sorts of Ring

TRENTON, N. J.—Editor THE AUTOMOBILE:—Seeing that there are now upon the market so many different kinds of piston rings, all having as their aim the removal of the small leakage always possible with ordinary rings, it occurs to me that readers of THE AUTOMOBILE may be interested in hearing how we were led to design our ring, since during our experiments we made some discoveries that were, to us, extremely interesting.

When first we started on piston ring production we took a most efficient type of ring which was a compound form of angular cross section. We knew that this type of ring gave great efficiency on installation, but that the efficiency fell off with use, and we therefore proceeded to make a careful study of the reasons for this loss. It proved ultimately to be a fact that while the joints of the two sections were held opposite to each other by means of a dowel, slight wear would allow the respective openings to separate. As soon as the gases under the high pressure generated by the explosion found their way behind the ring through the upper section joint, there was a corresponding point of egress developed at the joint in the lower section. That lubricating oil was working past the ring freely, was proved to us by the presence of quite heavy carbon formation behind the ring in the piston groove.

Weakness of Compound Ring

We made several types of compound ring and these were all tight so far as leakage past the face or behind was concerned; but we had difficulty in obtaining sufficient distention to prevent the ring riding over the lubricating oil film; that is to say, the ring did not give a clean scrape to the cylinder wall.

By chance one of our compound rings lay for some time beside a pot of zinc chloride used for soldering purposes, and thereby became covered with a uniform coating of rust. On picking up this ring in order to give a demonstration of the efficiency expected, we noticed that the friction created between the two ring sections by this slight coat of rust was sufficient to offset the expansive properties of the assembled ring; which we took as a proof that the inner member lost most of its expansive efficiency by friction against the outer member.

Further, we found that there was a tendency for the outer member to slip the ring groove as the piston was being put into the cylinder. These two facts turned our attention to the construction of a one-piece ring.

Before we reached this point however, we had noted, by a careful examination and calibration of numerous stock rings, that the average ring, in both the one- and two-piece construction, showed considerable "warpage" both circumferentially as well as in plane section. In fact some rings showed a "curl" of 3/16 of an inch.

Result of Using Unseasoned Materials

From this point developed our rule to turn and cut our castings into ring blanks, and then allow them to "set"; in preference to treating the entire casting as a whole in this manner. The lighter ring sections seasoned more readily and efficiently. We had by this time decided in favor of the concentric rather than the eccentric type of construction, from noting that the lesser area exposed on the cut side of an eccentric ring, through the presenting of less area to the side walls of the piston ring groove, shows a corresponding increase of side wear.

On the question of internal peening for expansion, after careful study thereof, the decision was reached that the stresses set up in the ring by such treating were offset in a short period of time by the pounding of the explosions above the piston, accompanied by the attendant vibrations developed by the motor when under power. In other words the natural stress of the iron was all that remained.

As to finishing the ring for dimensions, there was but one way to accomplish this with any degree of satisfaction, and that was to grind the ring circumferentially while held under compression. To accomplish this we inserted the cut blanks in tubular forms, that allowed the ring to exert its expansive properties in a perfectly natural manner, being held under circumferential control only. When clamped on the grinding form the sleeve is removed, and the face ground with micrometrical accuracy.

Yet the fact remains that there are practically no perfectly round cylinders in use today. This seems rather a broad assertion, but when the further seasoning of cylinders developed by the many changes in temperature of a motor when in actual use, is taken into consideration, as well as the side thrust of the piston against the walls, it is readily understandable.

From this we found that practically the only way in which perfectly fitting rings could be obtained was by the motor itself in driving a distance ranging from 500 to 1,000 miles in actual use, or by the driving of the assembled motor by outside power, using a light "soup" for a combined lubricant and cutting compound, for a period of time ranging from 5 to 20 hours.

On the point of relationship between width of ring face to diameter, our preference is to work on the ratio of 1-16 inch of face for each inch of cylinder bore. This means that for 3-inch pistons the ring would be 3-16 inch wide; for pistons 4 to 5 inches in diameter, 1-4 inch in width or possibly 5-16 inch.

As to the practical benefit of using an improved form of piston ring, I may say that it is usual for us to receive reports to the effect that oil consumption has been reduced very greatly indeed on motors which our rings have been fitted. In one particular case a car which used to use a gallon of oil for every hundred miles was afterwards enabled to cover 400 miles on the same quantity.

It is of course a fact that where high piston speed is made and maintained the compression and explosion of the gas takes place so very quickly that a close fitting piston without any rings will very nearly approach in efficiency another piston fitted with any number of rings. It is at slow speeds that the possibility for leakage of the ordinary style of ring becomes noticeable, and seeing that the ordinary automobile motor only occasionally operates at really high speed it seems to us rings which will enable the oil consumption to be cut

down cannot be anything but advantageous. There should be less friction when using two or three rings which have no gap to allow the escape of gases than where the same degree of tightness obtained by the use of five or six ordinary rings, to say nothing of the increase in piston weight called for by increasing the number of rings. For these reasons we think that the ordinary old-fashioned piston ring is doomed to disappear from the automobile.—CARL H. ENDEBROCK, President End-Oxy Appliance Co.

Favors Adoption of Metric Standards of Measurements

ARCADIA, CAL.—Editor THE AUTOMOBILE:—Following my letter on this subject which you published in the Rostrum for January 28, the change of systems would entail prodigious difficulties, as you say, but it is feasible. These difficulties have accumulated by the tremendous industrial development of this country; and the longer the inevitable change is postponed, the more the obstacles will correspondingly increase. I make an attempt to enumerate below my personal views regarding the easiest steps for the adoption of the metric system by the United States.

First: Start an energetic educational campaign by the press and especially by the automobile and technical publications to convince the American public of the fact that our present system of weights and measures is antiquated and confusing and that the metric system is the only logical and reliable one.

Second: Passing of a federal law that the metric system will be introduced in this country on a certain date—say January 1, 1917. In order to insure a gradual transition from one system to the other, the country should be first taught to use metric figures as well as the old figures, in order to more easily acclimate itself to the new regime.

Third: A federal appropriation for the making of an entire new set of metric measures and standards to be distributed free of charge to the trades and industries of the United States. The exclusive use of these measures would be of course compulsory on and after the above mentioned date, January 1, 1917. Exception would of course have to be made for the measuring and computing of repair parts pertaining to old goods.

Fourth: The rational but firm enforcement by the U. S. government of the metric system law.

These personal views will perhaps seem optimistic and imaginative; I do not doubt that they can be improved upon. The American public should be expected to contribute all the co-operation and the good will possible. Manufacturers and mechanics would most welcome the new system as they are all eager to enjoy its benefits. Concerning the automobile industry, the branch that actually manufactures the largest amount of measured parts, it can be asserted that the change would not prove very burdensome, considering the subsequent benefits. All the new motor cars would be metrically manufactured, and as the average life of a car is about six years, the drawback of making inch-measured parts would only seriously extend itself for a like period. Regarding products of longer life, most of such of their parts needing renewal, could gradually be replaced by metric ones. In 12 years, owing to the up-to-dateness of the American nation, the old system would be entirely forgotten.

It is a matter of fact that when accurate mathematical figures in any branch of science are required, the metric system naturally imposes itself. The Ampere, the fundamental electrical unit, deposes 0.00118 gram of silver per second. The international Ohm calls in its description for a column of mercury 106.3 centimeters long and one square millimeter sectional area, and so forth. You can find the metric system firmly implanted along the whole electrical line.

In conclusion, let it be recalled that the French (metric) horsepower is equal to 735.75 watts, or 736 watts. The British horsepower is equal to 746 watts. The French horsepower is then slightly smaller than its British brother, in the proportion of 1.0136. The French is equal to 75 kilogrameters seconds, and the British is equal to 33,000 foot-pounds-minutes. The value of a kilogram being about 2.204 pounds, and the meter, 3.28 feet, we have again the proportion:

$$\frac{75 \times 60 \times 3.28 \times 2.204}{33{,}000} = \frac{32{,}531}{33{,}000} = 1.0136 \text{ (in favor of British H.P.)}$$

same proportion as above.

That proportion 1.0136 is very small, yet confusing. Why not eliminate it by making the British or American horsepower 736 watts, or making the French horsepower 746 watts? To settle this question, and for the sake of having one universal rating of power, why not then abolish the horsepower as a unit of force, and adopt the Kilowatt which is the same all over the world?—CHARLES VIVIER.

—Some months before the war the French government officially abolished the term horsepower and made the standard of power the kilowatt, which it is in France today.—Editor.

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British to Standardize 11 Tire Sizes

NEW YORK CITY, Feb. 20—In 1913 the tire committee of the Society of Motor Manufacturers and Traders, England, established standards for twenty-three different sizes of pneumatic tire rims. It is announced in *The Autocar* for February 6, 1915, that there is shortly to be a reduction in this number to ten, while eleven different sizes will be standardized for tires themselves. Of this range of tires two of the smallest fit the same rim, but of the rest each has a rim to suit it. The suggested standards are as follows:

Millimeters	Inches	Millimeters	Inches
700 x 80	27.5 x 3.14	820 x 120	32.3 x 4.72
*700 x 85	27.5 x 3.34	880 x 120	34.6 x 4.72
*710 x 90	27.9 x 3.54	895 x 135	35.2 x 5.31
760 x 90	29.9 x 3.54	935 x 135	36.8 x 5.31
810 x 90	31.9 x 3.54	915 x 175	36.0 x 6.88
815 x 105	32.1 x 4.13		

*These two tires fit same rim.

The Autocar points out that these standards neglect the demand for tires of larger diameter for use in the rougher of the British colonies and states that the idea is to leave the larger sizes unstandardized for the present.

It is, of course, to be regretted that there is the fundamental difference between the British standards which will take effect throughout Europe and those in use here, which must necessarily lie between the inch and the millimeter, and it seems unlikely that American-made tires will fit the new standard rims unless made specially to conform to the S. M. M. and T. specifications. It might also be pointed out that it will at once become a drawback to an American car in Europe if it has not rims to take the standard tires, a matter which is worthy the serious attention of exporters.

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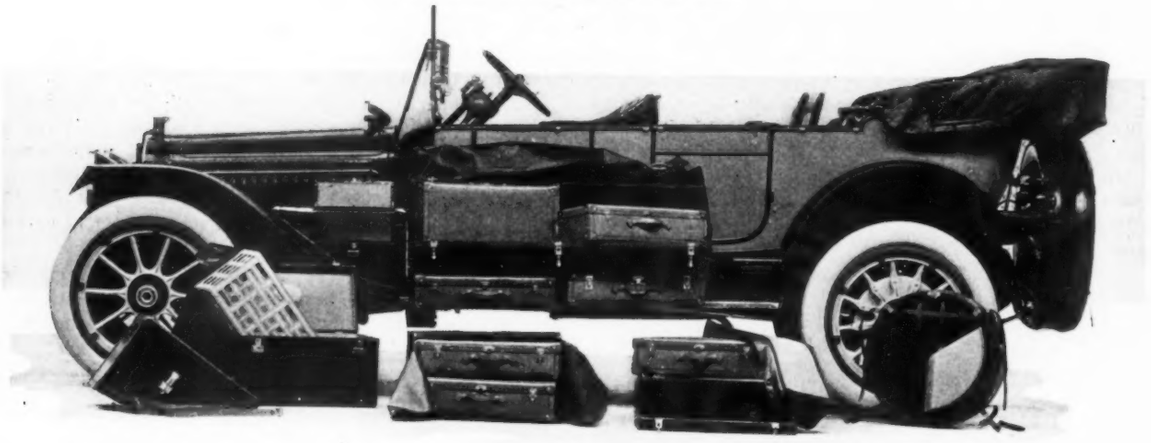
Better Straining of Gasoline Possible

THE COMING of the vacuum will make the proper straining of gasoline even more important in some ways than it has been in the past. Not that dirt could very well choke up the vacuum tank, but the latter contains certain valves that must work better clean than dirty. Every motorist has become accustomed to the idea that it is necessary to clean out the carbureter at frequent intervals, if trouble on the road is to be avoided, though there are a few who have fitted their cars with really efficient filters that trap all dirt and all water also. Such filters are not expensive, and are easy to attach in places where the filtering gauzes can be withdrawn for cleansing with great facility, and it is surprising that a much better filter than the average sort is not to be found on every automobile. A good filter is a petty detail doubtless, but it is one of those little things that go to make the "class" of a chassis, and with vacuum feed it could be mounted inside the hood in a most accessible place.

Solving the Baggage Problem

Clever Provision Being Made by Makers for Carrying Luggage, Tools and Spare Tires



Illustrating the amazing amount of space for carrying baggage which can be rendered available by the use of suitable trunks and suitcase carriers

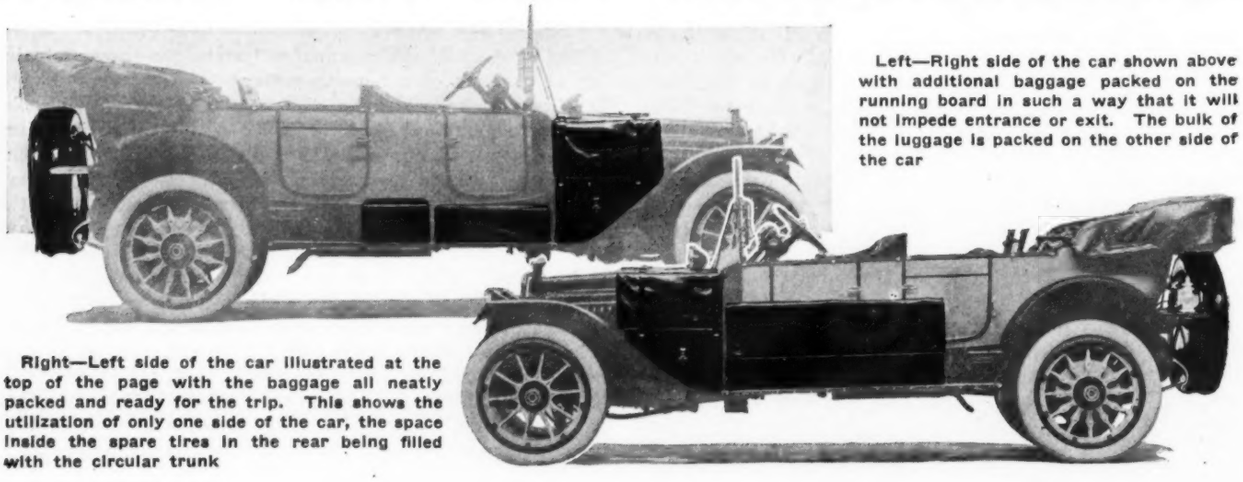
WITH an exceptional unanimity the automobile manufacturers of this country have turned their attention toward a logical solution of the baggage, tool, and tire carrying problems. There are two reasons for this sudden attention to a problem which is of the utmost interest to every owner who tours to any extent in his car. First, the development of the streamline form of body and the desire which went with this development to remove all interruptions from the contour of the body line has necessitated the inside storage of baggage and equipment. The second reason for this is the fact that automobile owners themselves have complained that they did not have sufficient room to store their luggage in a sightly and accessible manner.

Spare Tires at the Rear

This year we find that with few exceptions makers have endeavored to provide clean exterior lines in both the roadster and touring designs. Since both front doors are used with the left drive and center control, the spare tires which were in the way and of clumsy appearance when hung on the running board have been moved to the rear of the car. Here, upon a bracket rigidly fastened to the side members of the chassis frame, they are carried in a sightly manner without danger of putting uneven stresses on any part of the chassis construction.

In the roadster there is a marked tendency toward a complete concealment of the spare tire. The streamline roadster provides a gradual terminating line as well as a smooth entrance. In carrying out this plan, the automobile designer has almost without exception adopted the rear deck construction. This offers the opportunity of making use of the compartment provided beneath the rear deck for baggage or tires. When the rear deck scheme was first adopted many put the tires on the top of the deck leaving the space beneath for parcels, etc. This arrangement, while good so far as space is concerned, interferes with the general streamline scheme that has become popular and more to coincide with this arrangement than to provide extra carrying space on the deck, the tires have come to be stored in the compartment provided.

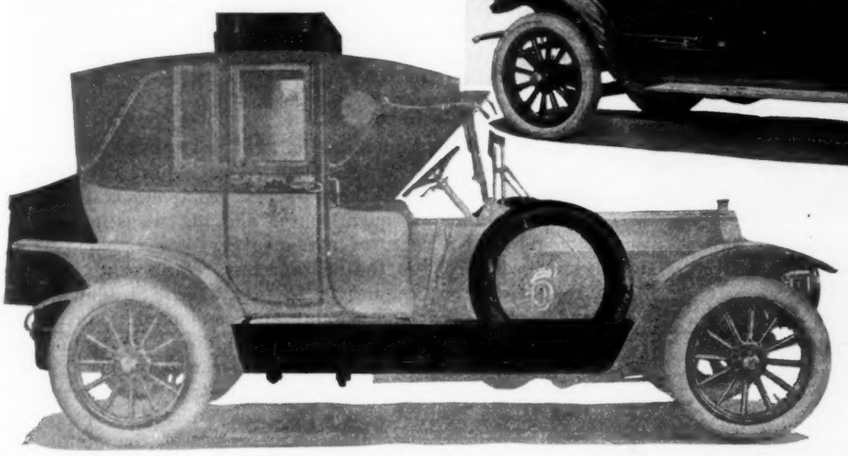
In the S. A. E. ideal car, which has been discussed through-



Left—Right side of the car shown above with additional baggage packed on the running board in such a way that it will not impede entrance or exit. The bulk of the luggage is packed on the other side of the car

Right—Left side of the car illustrated at the top of the page with the baggage all neatly packed and ready for the trip. This shows the utilization of only one side of the car, the space inside the spare tires in the rear being filled with the circular trunk

Right—The most common method of carrying baggage when on a long tour, suitcases being packed in the box carried on the trunk rack at the rear. Room for the small articles is provided in the tonneau and there is a large hinged robe rail of great capacity



Left—The Pierce-Arrow Motor Car Co. has built to order only a number of special touring landaus with extra lockers in the running board.. The car illustrated is one of these and shows the arrangement desired by a certain class of buyers who use this type of car for touring purposes

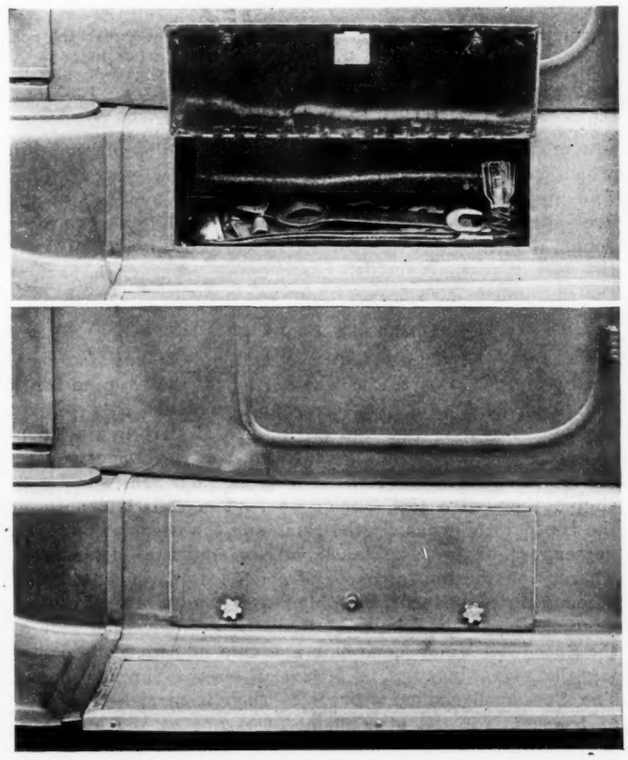
out the different sections of the society, and also at the general meeting, it seemed to be the balance of opinion that the ideal roadster should provide extra seats should they be in demand and at the same time should have these seats in such a position that they are invisible when not in use. This has been done on foreign cars by the use of a sliding panel which fits in the top of the deck, allowing seats of either one or two-passenger capacity to be folded out whenever desired. Of course, with this method of carrying extra seats the compartment beneath the deck is taken up and the extra tires must be carried in some other place. The most popular position is at the rear on a bracket similar to that used in the touring models.

Certain companies are carrying the battery box on one running board on their larger models and providing a large baggage-carrying box capable of holding three suit cases on the other board. This is only on large cars which have such a long wheelbase that when the box is placed on the running board against the front fender, there is no interference with entrance in either foredoor. One of the companies that employs this scheme makes a practice of carrying the box only on the larger model, while on the smaller models it adheres to the clean running board idea that is by far the more popular.

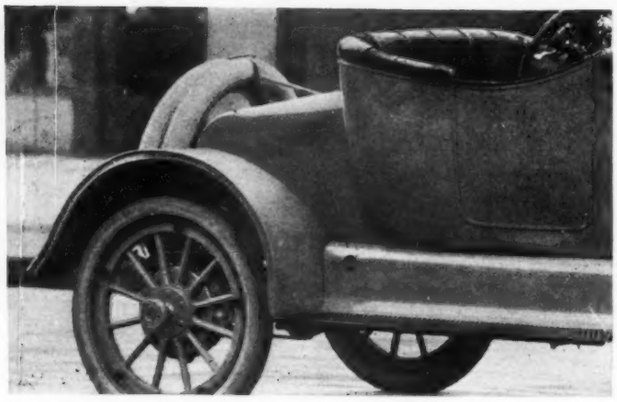
The increasing adoption of pressure gasoline feed, owing partly to the necessity of using a higher carbureter with the lower grade fuel used nowadays, has left the space beneath the front seat clear for other purposes than the tank. We find that in cars which formerly carried the tools under the rear seat, these have now been moved up to the position formerly occupied by the tank, while beneath the rear seat there is ample space for a number of small packages. This space has been further amplified by the fact that while the side curtains used to be carried under the rear seat they are now folded up and are carried within the top itself.

Special Extra Equipment

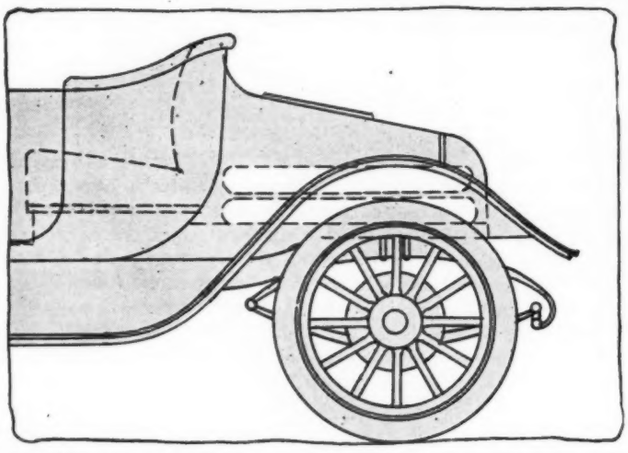
Many of the automobile manufacturers have made a study of the needs of owners who intend to use their cars for long distance touring. The conditions which such tourists meet are abnormal and it is of course not to be expected that the car driven about the city streets will ever be called upon to carry the amount of baggage necessary for a tour through wild and unsettled country. To be provided for the needs of the touring motorists two methods have been adopted by the American manufacturers. First, extra baggage-carrying equipment in the way of trunk racks, suitcase boxes, etc., especially adapted for the particular car under consideration are put on the market by the manufacturer of the car. The other scheme is to take advantage of certain parts of the car for the location of extra compartments. One of the favorite locations for these compartments is beneath the running board where a long, shallow space for small articles can be easily accommodated. Another method is to place behind the splash guard compartments for carrying the batteries or tools, leaving the room under the seat for other baggage.



Ingenious method of carrying tools in a compartment in the running board apron as used on the Stearns



Type of roadster in which the tools, baggage, etc., are carried in the compartment under the rear deck, while the spares are attached at the rear



Phantom view of roadster type using compartment under the rear deck for carrying spare tires, with room for other luggage

Many manufacturers specify among the extra equipment which they will furnish at extra cost, a trunk rack. These are of more or less similar design, generally of the type which has become familiar in the past few years. They fold up against the back of the body when not in use and are capable of supporting a great weight while passing over rough roads. There are a few concerns who take pride in the fact that they furnish these trunk racks as a part of the equipment of the car without extra cost.

Some Favor Using Running Board

It cannot be denied that the opinion of manufacturers differs to a large extent on whether or not the running board should be kept altogether clear and no doubt the voice of the sales manager has had an influential part in the adoption of the clean running-board in many automobile factories. With the roadster, the proposition is somewhat more simple than with the touring car. The chassis length of the two cars is generally the same and the needs of only two passengers have to be taken care of on a roadster body, whereas on the touring model from five to seven have to be accommodated. Naturally, this leaves more room for baggage on the roadster model. C. R. Green, chief engineer of the Speedwell Motor Car Co., states that he believes in carrying the extra luggage in a carrier on the running board. The Speedwell company provides such a carrier consisting of brackets for the attachment of straps at the option of the car owner. These straps and brackets are used to secure baggage such as suit cases and steamer trunks to the running-board. As the Speedwell car carries the tires in the rear they are prevented from carrying baggage in this position, but since the running boards are clear, except when baggage is carried, this scheme works very well.

The Nordyke & Marmon Co., maker of Marmon cars, is using on the larger car large boxes capable of carrying three or more suit cases. To balance this, the battery and tool box is placed on the opposite side in the same position. On the smaller model, where the streamline form is more closely adhered to, all the baggage is kept inside the car in compartments under the seats, and the running-boards are left clear.

Luggage Boot Is Good Practice

The H. H. Franklin Mfg. Co. is of the opinion that a luggage boot designed and constructed as a part of the body, placed in the rear of the passenger compartments is good practice and very frequently used abroad, but estimates that it would take 2 years of persistent argument to make this layout seem right to the average buyer or prospect because it would not look regular. "In fact," the Franklin officials say, "Nothing but the regular and commonplace in carrosserie design is safe practice in building American stock cars." In following this opinion the company has provided a strong trunk rack that will carry two trunks or several suit cases, attached to the rear of the car, as stock equipment.

L. E. Wilson, general sales manager of the Motor Car Mfg. Co., maker of the Pathfinder car, in speaking for the latter concern, holds a strong opinion on the baggage-carrying proposition. He says, "We feel that the clear running-board was a great mistake, and have changed back to larger boxes on the running-board. This allows us to provide three times the luggage space we have had previously while not interfering with passengers entering the doors." The Pathfinder car also has extra carrying space, located under the frame in the rear.

Baggage Rack Is Standard with Few

The Pierce-Arrow Motor Car Co., is another of the few concerns which include a baggage rack as standard equipment. Spare tires on the Pierce car are carried on the right running-board, leaving the rear end free for a touring trunk of large size when such is required. For the small articles, ample space is provided in the tonneau of the touring cars, and there is a large hinged robe rail of great capacity. This company has built a number of special touring landaus with extra lockers incorporated in the running-board. These are only to special order. One of these landaus, a 1911, 66-horsepower, is illustrated herewith. Such a car is, of course, only built to order but it shows the arrangement desired by a certain class of buyers who use cars of this type for touring.

The Packard Motor Car Co. has approached the problem in a different way. Realizing that the user of a large car will very often want to make long trips and to carry considerable baggage with him, this concern has been offering for the past three years a special set of suit cases, trunks, etc., as baggage-carrying equipment which can be purchased in entire or single pieces as desired. This equipment is attached chiefly on the outside of the car on the trunk rack, running-boards or fenders, and in this way does not interfere with the roominess of the car, and does not cause the passengers in the tonneau any discomfort. Some of the units of these baggage-carrying outfits are illustrated on these pages.

These are special examples, however, and the average touring car of the 1915 season has very little carried on the running-board or in exterior positions. The use of the rear gasoline tank, with the tires swung in the rear, the tools under the front seat, the side curtains folding in the top, and the space beneath the rear seat clear for packages is the general layout of the five-passenger bodies. When the owner of such a car desires to take an extended tour he most often straps his extra luggage on the running-board in

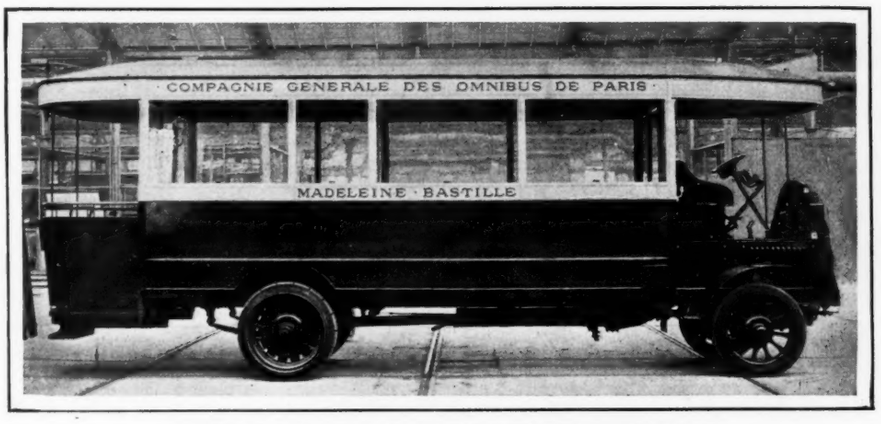
suit cases or similar devices. If the tank is under the cowl, leaving the rear a little more free, a baggage rack is often installed, or another scheme is to make use of the handy circular trunk which fits within the spare shoe. These are now made in many styles and are well waterproofed.

Sacrifice Stream Lines on Long Tours

Where the owner packs his baggage in suit cases, etc., on the running-board, he is often led to make a clumsy job and to find that the shaking of the car over a rough road will dislodge the articles. It is surprising the amount of strain that is put upon the fastening of baggage under the stresses of a pitching car. Nowhere could this be seen more plainly than in a recent Glidden Tour in which many private owners traveled the route with their baggage carried in various haphazard ways. All kinds of troubles were experienced from the start to the finish of the run by these owners, simply because a well-designed baggage-carrying space for this extra emergency had not been provided. For this reason many companies recommend that instead of depending on roughly tied bundles lying loosely in the tonneau that it is better on a long tour to sacrifice the streamline appearance of the car, and to make use of the running-board to carry suit cases in a suitable box.

Better Bodies on Paris Motor Buses

PARIS, Jan. 22—Since the evening of the first day of August no motorbus has been seen on the streets of Paris. The government order to mobilize entailed the immediate withdrawal from public service of the 1,100 buses operated by the Paris General Omnibus Co. Passengers were bundled out with no more consideration than refuse and since then they have had to find other means of locomotion, which often meant the use of their legs. Immediately after the loss of its entire fleet of motorbuses—for when the war is over not many of them will be fit to enter public service—the bus company set to work to produce a new and improved model. After considerable difficulties it has been possible to build a certain number of these vehicles, but the public is unable to obtain the use of them, for no assurance can be obtained from the army that the vehicles will not be seized for military purposes if placed on the streets. Thus the peculiar situation has arisen of a public transport company having a set of vehicles almost ready for service, the public clamoring for their appearance, and the fear of the military preventing either party obtaining satisfaction:

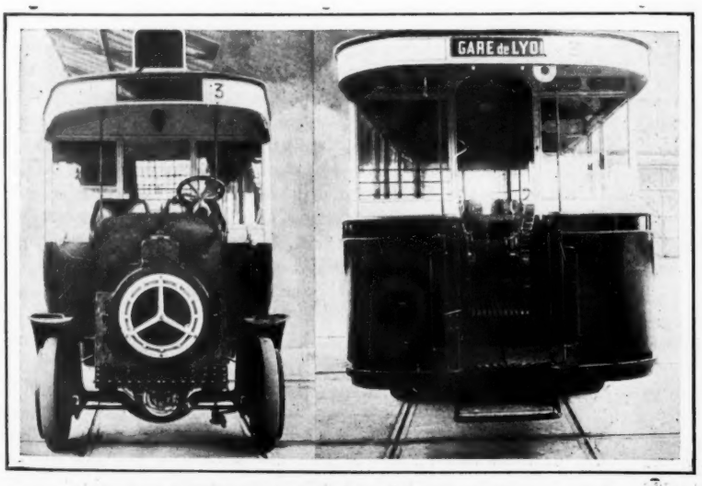


Side view of one of the new type of Paris motor bus

Chassis features have undergone few changes in the new Paris motorbuses. They have four-cylinder overhead valve motors of 4.8-inch bore by 5.5-inch stroke, placed under the driver's feet, with shaft drive to bevel rear axle, without the use of torque or radius rods. A three-speed gearbox is fitted, but the gear ratios are of such a nature that practically all work can be done on second and third; the first is an emergency gear for starting on hills.

Body Features Refined

Body features have been refined. The single deck type is adhered to, with side windows much larger than formerly, those on the right hand side being fixed and those on the left movable. This is done in order to meet the objections of people against drafts. The roof is flatter, with no other projection than the service letter at the front. By means of an improved construction it has been possible to gain half a ton in weight and to increase the interior space without altering the external dimensions. Seating is transverse, the front half of the bus being for first-class passengers, with leather upholstered seats, and the rear portion being second class. These latter seats are not upholstered. There is a large rear platform for second-class passengers standing.



Front and rear of new Paris bus design

Electric Lighting Used

In place of the acetylene lighting set used on the old type buses, all the new models have electric lights from a dynamo driven off the motor. Direction boards do not project above the roof of the bus, as on the old type, but are inserted in the panel, just below the edge of the roof. They are illuminated by electricity at night. A circular type of splashguard is fitted to the wheels. This guard is a flat rubber ring practically the same diameter as the tire, attached to the outer face of this latter, with an interval of about 3-4 inch between tire and splasher. The guard is cheap and durable.

The Rostrum

Clutch Trouble Overcome by Adjustment

EDITOR THE AUTOMOBILE:—I have a 1914 Hudson 6-40, and would appreciate information regarding the following:

1—When you press the clutch pedal the disks do not disengage. That is, the gear grates in changing. I have washed out the clutch and renewed the same with half kerosene and half cylinder oil as per instructions, but it does not relieve it.

2—How can I take the tarnish off the lamps which are nickel plated?

Russellville, Ky. P. C. ANDREWS.

—To overcome the clutch trouble, remove the pin from the adjusting clevis connected to the clutch throw-out yoke. Unscrew this clevis two or three turns and put it back in its place. This will allow the clutch to be thrown out farther. It would be well to remember that in washing out the clutch with kerosene, it is necessary, after you have put the kerosene into the clutch, to start the motor and sit in the driver's seat working the clutch pedal in and out a couple of dozen times while the engine is running. Then stop the motor, drain the kerosene from the clutch and refill with the correct mixture of kerosene and cylinder oil, which should be thoroughly mixed before putting it into the clutch.

2—The most efficient way to remove tarnish is to take the nickel parts off and have them replated.

Energy Is Measured in Foot-Pounds

Editor THE AUTOMOBILE:—Will not a two-cycle four-cylinder motor give as great a torque and be as vibrationless, as smooth running, as noiseless and propel a car with as much smoothness as an eight-cylinder, four-cycle motor?

2—What is the difference between an ordinary motor and a high-speed motor?

3—What are the objections to steam cars?

4—How far will a gallon of gasoline run a steam car?

5—Does the White company make steam cars?

6—Do the cyclecars with 36 by 42-inch tread give satisfactory service?

7—How can I obtain instruments for charging storage bateries?

8—How strong a shock in pounds would the Gray & Davis and Westinghouse lighting and starting systems generate in high-tension wires? I mean by this, how hard a blow with a hammer would equal the shock of electricity in pounds? Would the shock from either system be hard enough to explode dynamite that required 40 pounds of pressure to explode it? I mean by high-tension wires, such wires as used in the transmission of current in a hydro-electric plant.

Cooper, N. C. SANFORD TEW.

—Insofar as a two-cycle, four-cylinder motor is concerned the number of explosions, and hence the theoretical torque, would be the same as for an eight-cylinder, four-cycle motor. Regarding the noiselessness, smooth running and absence of vibration, this would depend upon how the balancing elements were worked out.

2—Generally on a high-speed motor lighter parts, larger valves, and light-duty design are used to bring the horsepower curve to a higher r.p.m. before falling off. High-speed motors are designed to be used on a greater reduction than the lower speed, heavy-duty motors.

3—The biggest difficulty that the steam car has been confronted with is in the necessity for frequently renewing the water. This has been said to have been largely overcome in some of the late models. Another objection which has been urged against the steam car is in the necessity of carrying a pilot flame and having a somewhat more complicated control than the gasoline motor. Steam cars are still being made, however, and are operated by many who believe that the enormous torque which can be produced when necessary, the high speeds possible and the silence of operation meet their desires exactly.

4—The distance that a steam car may be operated on a gallon of gasoline is a variable factor, depending upon the weight of the car and many other varying features.

5—The White company no longer makes steam cars.

6—Cyclecars with narrow tread have been said to give satisfactory service, although the narrow tread has not seemed to appeal to public fancy.

7—The instruments necessary for charging storage batteries depend on the source of current, its voltage, etc., and these will have to be specified before details can be given as to what you need for a complete charging outfit.

8—It is impossible to measure electric shocks in pounds. The energy of a hammer or any other body which has been raised and let fall cannot be expressed in pounds simply, but only in foot-pounds, which is the product of the weight into the height through which the body falls, or the product of its weight divided by twice the acceleration due to gravity (32.16) into the square of the velocity in feet per second which it acquired after falling through the given height. If F is the weight of the body, M its mass, g the acceleration due to gravity, S the height of the fall and v the velocity at the end of the fall, the energy in the body just before striking is $1/2\ Mv^2$, or $\frac{Fv^2}{64.32}$. Either of the two expressions is commonly used to express the energy in a moving body. To transform electrical energy into foot-pounds, the equation that 1 kilowatt is equal to 44,236.5 foot-pounds per minute may be used as a basis. A kilowatt is 1,000 watts and therefore a watt is equal to 44.2365 foot-pounds per minute. A 6-volt current flowing at a rate of 1-6 ampere for a minute

would thus exert an electrical energy that would be equal to 44.2365 foot-pounds per minute.

Gas and Air in Carbureters

Editor THE AUTOMOBILE:—When proportion of air to gas is referred to is it by weight or volume?

2—Does weight or volume of air flowing through circular apertures vary directly with the suction?

3—If not, what is the law governing the flow of each for varying suctions?

4—What is the suction below and above the throttle of the carbureter in touring cars at low speed (400 r.p.m.) at high speeds (1,500 r.p.m.)?

5—The ideal carbureter is, I understand, giving the same proportion of gas to air at all engine speeds and throttle openings. Will ideal carburetion work satisfactorily, or is a richer mixture required at low speeds, due to close throttling and lower compression and at high speeds due to lower volumetric efficiency than when at intermediate speeds?

6—What is the comparative volumetric efficiency of a four- and eight-cylinder engine of same displacement where the eight-cylinder engine has one carbureter?

Port Henry, N. Y. J. H. THOMAS.

—1—When air to gas is referred to in carbureter practice it is generally by volume and not by weight.

2—The weight varies directly as the volume in a gas, when the temperature and pressure are constant. Therefore, for a given velocity of gas through a circular aperture the weight and volume will vary directly as the area of the aperture or, when circular, as the square of its diameter always assuming that both the pressure and temperature are constant and neglecting for the moment the co-efficient of flow. The suction or difference in pressure between the cylinder and the carbureter will determine the velocity of the flow of gas and hence the weight or volume of air or gas flowing will bear a definite relation to this difference in pressure or suction. This ratio will not be a direct one, however, for the reason that the co-efficients of flow through circular orifices will vary for each pressure ratio. For example, for a circular aperture 1 centimeter or .394-inch in diameter, the co-efficient of flow for a ratio of pressure of 1.05 is given as .555; for a ratio of pressure of 2.15 the co-efficient is .788. To express it as a formula, the theoretical velocity in feet per second of flow of any fluid, liquid or gas through an orifice is $v = c\sqrt{2gh}$ where h is the head or height of the fluid in feet required to produce the pressure of the fluid or gas and g, gravity acceleration. For gases this formula only holds good for small differences of pressure on the two sides of the orifice. The reason for the varying co-efficient of flow c is that the friction of the orifice and the contraction of the vein, or flowing stream, have an effect on the velocity.

3—This is answered under question 2.

4—No definite figure can be given on this as it varies on every carbureter and every car.

5—Richer mixtures are generally required at low speeds for easy starting. This is taken care of in most carbureters by an air-choking, or strangling, device. At high speed it is possible to work with a great amount of air, due to the inherent ease of carburetion at higher speeds.

6—If the manifolds are properly designed there should be no difference.

Current Circuits in Bosch Coil

Editor THE AUTOMOBILE:—Will you kindly trace out the current circuits both in writing and diagram to this type of ignition which I have on my Winton six-cylinder car, namely, the Bosch Dual system, type Z R-6? Would like to know both the primary and secondary circuits, including internal coil windings, when running on either magneto or battery side.

In a simple diagram will you trace out the path of current when starting button on coil is pressed and the coil vibrator with its shower of sparks is brought into use?

How is the primary winding of the magneto affected by the so-called grounding wire? Please make clear by a simple diagram. Am inclosing a sample of a diagram of above mentioned system except that this is a four-cylinder, whereas mine is a six. This diagram is anything but understandable in my opinion.

Boston, Mass. A SUBSCRIBER.

—1—To understand the dual system it is first necessary to have a general idea of what this method of ignition accomplishes. In the first place there are two sources of current, the battery and the magneto. There is one distributer which is located on the magneto and one set of spark plugs. The high tension coils for the magneto and battery systems are independent of one another, that for the magneto being wound upon the armature and that for the battery being incorporated in the switch. Referring to Fig. 1 a general wiring diagram of the entire system is given. In Fig. 2 a detailed diagram is shown of the coil circuits.

The circuit with the coil in battery position is as follows:

When the push button pointer is at the designation run, the current starts from the battery, follows the arrow through the heavy winding, which is the primary, up to and across spring marked N, to contact marked B, out on wire that runs from the coil to the battery contact breaker on magneto. When the cam causes this contact breaker to close, the current, in following the path, causes the iron core to become magnetically saturated. When the cam causes the battery contact breaker to open, this magnetism dies away, and the reaction induces a current in the secondary winding. This secondary current is led out by wire No. 4 to the center point of the distributer, and from there to the plugs. At each opening of the battery contact breaker, a single spark is given to the plug.

When the button is turned to the designation "start", the following occurs:

Pin E will engage in slot F, and contacts C and C1, and

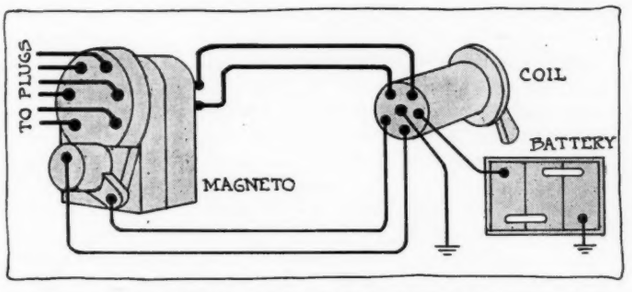


Fig. 1—Wiring diagram of the Bosch dual ZR-6 ignition system

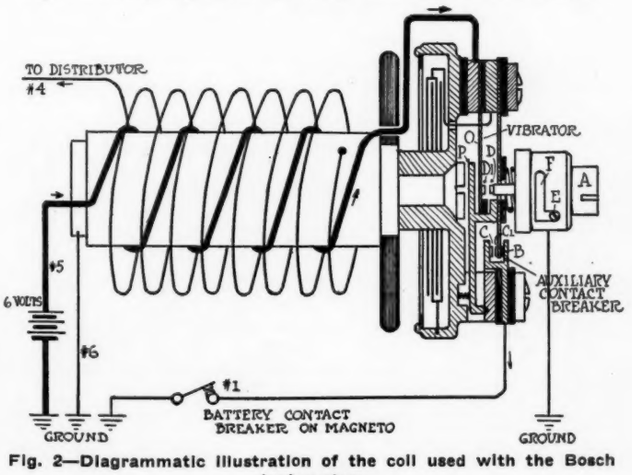


Fig. 2—Diagrammatic illustration of the coil used with the Bosch dual system

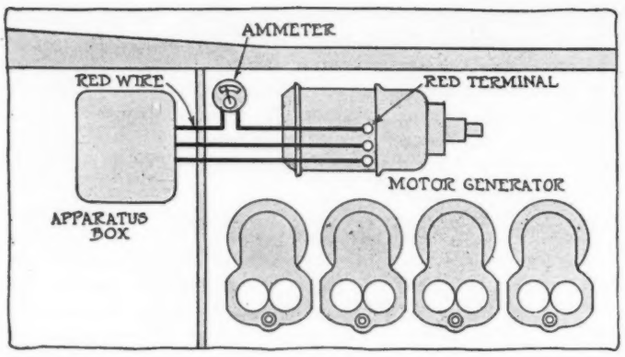


Fig. 3—Method of connecting an ammeter on a 1914 Cadillac

D and D1 are made. It is to be borne in mind that the upper part of the coil or the part that encloses this button is in metallic contact with the core, therefore, it is in electrical connection with the core, and the core is grounded by means of No. 6 wire. The circuit, under these conditions, is as follows:

Starting from the battery, current flows through the primary winding up and across spring N, across contacts C and C1, through wire to the battery contact breaker on magneto. Also, will go across the vibrator spring O, to and across contacts D and D1 to ground, by means of the metal part of button. This gives us a divided circuit, each of which are grounded. No action takes place until the cam causes the battery contact breaker to open, and when this occurs, one of the parallel circuits is removed, and the primary current then is from battery through the primary winding, across vibrator spring O, to platinum contacts D and D1, across metal part of button to ground. The core becomes magnetically saturated, and in doing so, attracts armature P which causes contacts D and D1 to separate, in this way open-circuiting the circuit, and this allows the vibrator P to return to its normal position, and again closes contacts D and D1, making the coil under these conditions, a vibrating one. The vibrating action induces a current in the secondary winding, which appears at the plugs in the nature of a vibrating spark. The vibrating and the single spark feature are both controlled by means of the battery contact breaker on the magneto.

The above takes in both the Run and the Start positions of the button.

Inasmuch as it is desirable to obtain a spark when the engine is shut down, regardless of whether the battery contact breaker on the magneto is open or closed, it can be obtained in the following manner:

If, for instance, the engine comes to rest in such a position that the battery contact breaker is closed, on pressing the button A, we cause contact points B and C1 to open and immediately close on C and C1. For each breaking of the circuit under these conditions, we obtain a single spark at the plug. Now if the engine comes to rest with the battery contact breaker on magneto open, on pressing button A, we first open contacts B and C, and a little further movement of the button causes contacts D and D1 to be made, which will complete the primary circuit and give us a vibrating spark.

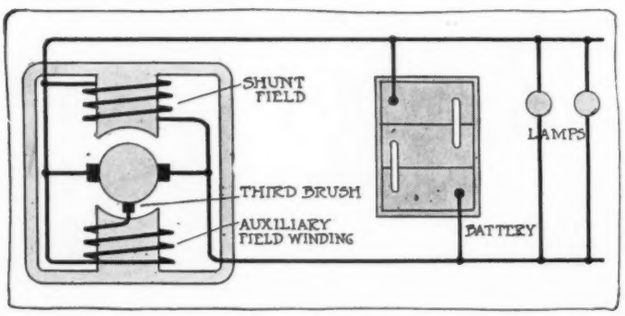


Fig. 4—Diagrammatic wiring scheme to illustrate third brush regulation

Explanation of Third Brush Regulation

Editor THE AUTOMOBILE:—In THE AUTOMOBILE for January 21, page 145, an explanation of the third brush system of voltage regulation was given. On page 147 of the same issue is a wiring diagram of the same system. Will you kindly show the path the current takes in this system at both low and high speeds? In other words, account for the automatic voltage regulation.

2—Why the excessive voltage rise in the generator when the battery is removed and the car operated? I understand that this not only happens with the third brush system but with the ordinary shunt wound generators used, which when the battery is removed the shunt field remains undisturbed.

San Francisco, Cal. A. S.

—The two main brushes divide the coils of the armature into two halves, and the full pressure furnished exist between the two main brushes which are diametrically opposite one another. At the same time, smaller differences in e.m.f. exist between other segments of the commutator. This is exactly similar to what happens with a battery consisting of a number of cells connected together in series. Before a maximum pressure or e.m.f. depends upon the difference in pressure between the extreme terminals, but smalelr differences in pressure are available from any of the other terminals along the line.

When arranging an auxilliary brush to bear upon the commutator and connecting it to coils of wire wound around the field magnets, currents of varying strength because of varying pressure will be caused to flow through these coils surrounding the field. This current may supply the entire magnetic circuit or on the other hand it may neutralize the current of another coil. A diagram showing the circuits involved in this method of regulation is given in Fig. 4. As the speed of the armature increases, the magnetic lag causes a greater amount of current to flow through the auxiliary brush. This may be moved around the commutator and the current taken from it can be made to either assist the main coils at low speed or to oppose them at high speed.

2—The only influence that the removal of the battery could have on the circuit would be that which would be due to the removal of the counter e.m.f. and hence it would depend upon the method of regulation of the system to what degree this overloads the generator.

Connecting Ammeter on 1914 Cadillac

Editor THE AUTOMOBILE:—How can I connect an ammeter on a 1914 Cadillac? I wish to arrange it so it will show charging rate and discharge also, except when the starter is being used as the meter is not of sufficient capacity to indicate the current used by the starter.

Tarrytown, New York. R. E. HOPKINS.

—After placing the ammeter on the dash disconnect the red wire from the generator and connect it on one side of the ammeter, then connect another new wire from the other post of the ammeter to the generator binding post from which the red wire was disconnected. If the ammeter indicates in the wrong direction reverse the wires on the ammeter studs. See Fig. 3.

Loose Pin Causes Knock

Editor THE AUTOMOBILE:—In my Chalmers 36 there is a slightly loose wristpin in one cylinder, although there is no apparent knocking until the motor is throttled down below

10 miles per hour. Even then the knocking is only slight. If this is very harmful to the motor, please give directions as to its remedy.

Detroit, Mich. JAMES C. FERRY.

—If you are sure that the knock is in the wristpin, it would be a good thing for you to repair it as the time required would be slight and it will eventually have to be done any way when wear progresses further. The wristpin on this model is fastened in the piston by a set screw and in the upper connecting-rod bearing there is a bronze bushing. The knock is caused by the wear either on the bronze bushing, the wristpin or both. You can reach the wristpin by loosening the lower connecting-rod bolts and pulling the piston through the bottom of the crankcase after having first removed this by draining out the oil and then taking out the bolts which hold it.

A cursory examination will tell you whether it is the pin, bushing or both which are worn. If it is the bushing the cost of a new one is $1.25, the pin costs $1 and the work of putting them in would generally cost you $0.75 an hour if done by a repairman.

It is possible that you will find the knock in the lower connecting-rod bearing instead of at the wristpin. To cure this it will be necessary to remove some of the shims and thereby tighten the bearing cap upon the bearing. Be careful not to get the bearing too tight when this is done. The method of taking down the motor and removing the shims is shown in Fig. 5.

Graphite Paint Prevents Rim Rust

Editor THE AUTOMOBILE:—Why is a six- or eight-cylinder car said to be better than a four?

2—A one-cylinder stationary motor generally has a governor. What acts as governor in a four-cylinder?

3—After wheels get rusty under the tires, what is the best thing to use to prevent recurrence of same.

4—When going into another state how long can one stay in that state before being compelled to take out a license?

Strong, Me. L. T. C.

—1—The gain claimed for an increased number of cylinders is that the torque is more continuous with the greater number of cylinders, due to the fact that the power strokes overlap one another to a greater degree. This is the basic reason generally advanced although a pro and con discussion would more than fill these pages.

2—A governor is not often used on a four-cylinder passenger-car motor because the speed is being constantly varied by the driver. On commercial vehicle motors governors are placed on the engines so that the trucks will not be operated at a speed high enough to cut down the life of the truck to a material extent.

3—The rust should be removed with emery cloth and the rims then painted with graphite.

4—This varies with different states and if you will mention the particular states to which you have reference this will be answered through The Rostrum. As a general rule, one can stay from 10 days to 2 weeks in another state without being compelled to take a license.

Determining the Brake Horsepower

Editor THE AUTOMOBILE:—Please explain and give formula for finding the brake horsepower of an electric or gasoline motor.

2—Does the size of the pulley make any difference?

3—In an article on starting and lighting systems in the January 28 issue of THE AUTOMOBILE mention was made of a certain starting motor having a stalling torque of 21-foot pounds. What does this mean?

Worcester, Mass. W. C. W.

—In finding the brake horsepower of a motor from readings on a braking system such as the Prony brake, the

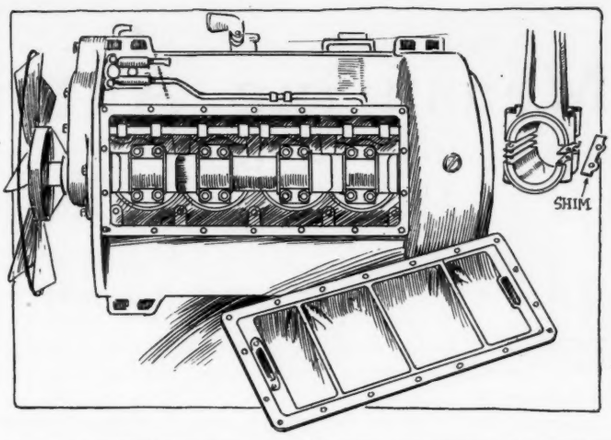


Fig. 5—Illustrating removal of Chalmers crankcase and showing location of connecting-rod shims

method that is followed is simply one of calculating the leverage exerted in multiplying it by the distance moved through. The brake primarily consists of a lever connected to a revolving shaft or pulley in such a manner that the friction induced between the surfaces in contact with it tends to rotate the arm along with the shaft. The tendency to rotate is counterbalanced by weights which are hung on the end of the lever. In order to measure the power for a given number of revolutions of the pulley it is only necessary to add weight to the scale pan until the friction induced just balances the weights and the lever or arm remains in a horizontal position while the shaft revolves at a constant speed. The formula then used is as follows: If P is equal to the power absorbed per minute, W the weight acting on the end of the arm, A the length of the arm in feet from the center of the shaft, V equals the velocity in feet per minute at a distance A if the arm were allowed to rotate at the speed of the shaft and N equals the r.p.m.; the horsepower is indicated by H.P., then, P equals W times V, or 2π ANW.

Since H.P. equals WV divided by 33,000 we have H.P. equals 2 πANW divided by 33,000. If we allow the length of the arm A to be 33 divided by 2π the formula becomes simply H.P. equals N.W. divided by 1,000. 33 divided by 2π is very closely 5 feet 3 inches. The value often used in practice for the length of the arm.

2—The size of the pulley does make a difference because if the amount of the surface exposed to rubbing be too small the resulting friction will be very irregular, due to the great unit pressure and hence the probability of insufficient lubrication. The jaws often seize the pulley under such conditions, producing shocks and vibration of the arm, thus rendering it difficult to make accurate readings.

3—This means that a torque of 21 pounds installed at the end of a 1-foot arm or its equivalent would stall the motor.

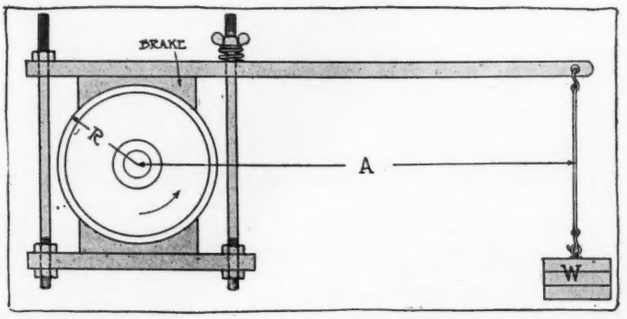


Fig. 6—Diagram of a Prony brake, showing the arrangement of the arm and weights

Measuring Automobile Efficiency

Car Performance Tested on the Block with Results That Can Be Reproduced on the Road

A Paper Presented to the Winter Meeting of the Society of Automobile Engineers
By A. B. Browne and E. H. Lockwood

MOTOR car testing should be conducted for two purposes:
First—To determine the actual performance of the car as a whole.

Second—To determine the relative merits of the different components of the car.

The first is of practical interest to the sales department, the owner and the general public. Interest in the second is confined largely to the department of engineering. But from the engineer's standpoint much useless experimenting could be avoided by an accurate knowledge of the relative performance of different motor vehicles, as at present designed, before attempting any comparison of constructional details.

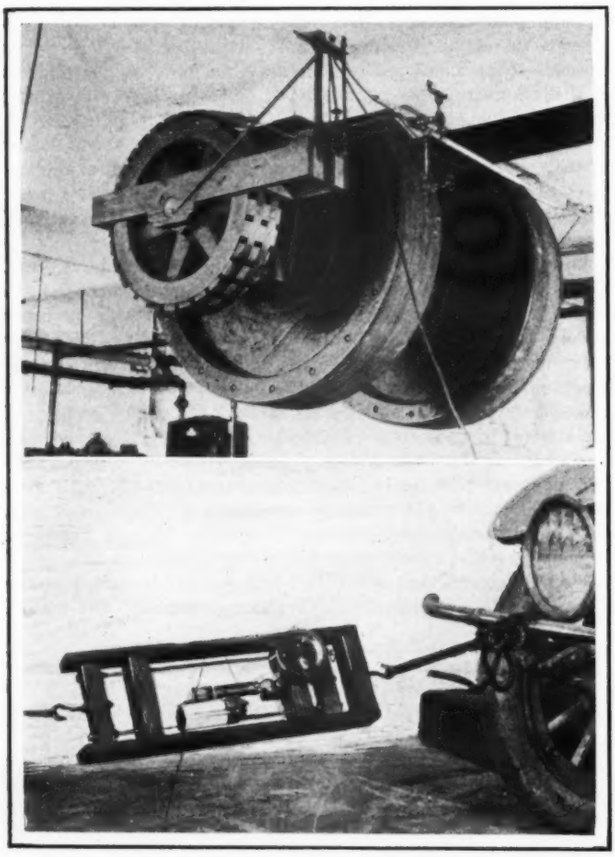
Road Testing

Any attempt at determining the actual performance of a car on the road is confronted with the problem of the uncontrollable variables introduced. Chief among these are the following:

(a) Condition of roadway.
(b) Force and direction of the wind.
(c) Frequent and uncertain change of gradients.

Among the instrumental difficulties encountered are:

(d) Lack of accurate apparatus for the determination of power, without a specially constructed car.
(e) Inability to measure fuel consumption accurately, owing to the vibration of the car body.



Upper—Brake and traction drums used for power measurements. The strap was originally made of steel band, lined with maple blocks. This has since been changed to a rope band giving smoother action

Lower—Recording dynamometer attached to the front of the car to determine the force required to pull it over the smooth, level floor of the laboratory

Proposed Tests of Performance

The purpose of this paper is to suggest a method of testing actual car performance on the block with results that can be reproduced on the road.

The method has been developed, and is at present employed, in the Mason Laboratory of Mechanical Engineering of the Sheffield Scientific School, Yale University.

An open stretch of level granolithic concrete floor about 75 feet long permits of towing tests to determine rolling resistance of the car at low speeds. For power tests the car is placed on traction drums, where appliances are at hand to measure power and pull at different speeds. The general appearance of the car entering the laboratory and undergoing various tests is shown in the illustrations.

Rolling Resistance

The first test is to determine the force required to pull the car slowly on the smooth level floor of the laboratory. This is accomplished by a recording dynamometer attached to the front of the car, as shown at the foot of the opposite column on this page. The recording elements consist of a Taber gas engine indicator, held by a suitable frame so that the pull compresses the spring, marking a line on the drum while the latter rotates under control of a clock.

Traction Drums

For power measurements the rear wheels are placed on drums whose top faces are level with the floor, while the front wheels remain at rest holding that end of the car in place. Connections are made from the rear axle to a permanent anchorage by chains and turnbuckles, affording adjustment to center the wheels on the drums and to resist forward movement when power is applied. The drums have faces 15 inches wide, treads centered 53 inches apart and the actual circumference of the drums is 17.51 feet; 301 revolutions of the drums are equal to 1 mile.

Power measurements are made on a Prony brake pulley, 36 inches diameter by 8 inches face, with a water-cooled rim, encircled by a rope brake. The brake is conveniently adjusted from the operating table on the main floor by a hand wheel and shaft telescoping over a worm shaft on the brake-arm.

The force required to rotate the traction drums with the brake strap removed is a necessary quantity. This has been determined approximately by placing a car exactly central on the drums and measuring the drawbar pull at different speeds by a spring balance. Thus far the friction force has been taken as 35 pounds, this being the average for cars of different weight, the change due to windage at various speeds having been too uncertain to be allowed for.

Drawbar Pull

The brake-arm, being equal to the radius of the traction drums, permits the direct determination of the drawbar pull from the brake load when the axle friction of the drums is included.

A Hopkins electric tachometer measures the speed of the traction drums, with the indicating dial mounted on the gauge board in front of the brake operator. This reads revolutions

per minute of the traction drums correctly within 3 per cent. at all speeds. Accurate measurements of speed are made by a mechanical revolution counter, driven by linkage from the traction drums. This counter is located at the operating table beside the electric tachometer, where stop-watch observations are made simultaneously with the counter readings at beginning and end of each run.

Gasoline Measurement

The fuel supply is contained in a five-gallon tank placed on scales weighing to sixteenths of an ounce; thence led by a rubber tube to the gasoline inlet of the carbureter. The rubber tube is sufficiently flexible to allow accurate weighing while it is attached to the can. An electric connection through a mercury well operates when the beam drops, giving a bell signal for the start and end of each run. This device has proved very convenient and accurate. One half pound of gasoline is regularly used for light loads and one pound for larger loads, giving runs of from 2 to 6 minutes' duration.

A hand air-pump is attached to the weighing tank, giving the necessary pressure to supply fuel to the carbureter.

Since the car is at rest and only the motor, transmission and rear wheels are in motion, the radiator is deprived of the active air circulation found on the road. To prevent overheating the cylinders a supply of cooling water is added to the radiator, with the overflow of hot water running to waste. The temperature of the escaping water is recorded and is usually kept at 160 degrees Fahrenheit.

Methods of Testing

Rolling Resistance.—In calculating the rolling resistance the following steps are taken:

(a) The tires are pumped to 70 pounds pressure.

(b) The car is towed on level floor, in high gear, declutched, to obtain the pull by dynamometer.

(c) The projected area of the car body is measured, the width across the mud-guards and the height from the running-board to the top of the windshield (half up), or to the top of closed cars. Allowance is made for streamline bodies by reducing the area slightly.

If the slow pull is denoted by r, the projected area by a, and the speed in miles per hour by S, the rolling resistance is calculated by the formula.

$$R = r + .003\ a\ S^2.$$

This formula is assumed to give the rolling resistance, in pounds, of the car at various speeds on smooth, level road, comparable to the laboratory floor.

After the car is placed on the drums and the motor warmed up by a preliminary trial, the following runs are made, during which careful measurements are taken of the load on the scales, speed, gasoline weight, temperature of cooling water and time of run:

Run 1—At 5 miles per hour, or slowest speed possible, load equal to rolling resistance, level.
Run 2—At 10 miles per hour, load equal to rolling resistance, level.
Run 3—At 10 miles per hour, load maximum at that speed.
Run 4—At 20 miles per hour, level road resistance.
Run 5—At 20 miles per hour, maximum load.
Run 6—At 30 miles per hour, level road resistance.
Run 7—At 30 miles per hour maximum load.
Run 8—At 40 miles per hour, level road resistance.
Run 9—At 40 miles per hour, maximum load.

Measurements are made during the nine runs and recorded on suitable log sheets.

Diagram of Results

From these records calculations are made in two groups, one for level road conditions and one for maximum load, both over the entire range of speed covered. These calculations are made for

Actual speed, miles per hour S.
Maximum drawbar pull D.
Level road drawbar pull R.
Gasoline, reduced to miles per gallon, level road f.
Gasoline, reduced to miles per gallon, full load F.
Effective drawbar pull $(D - R) = P'$
Horsepower at rear tires, level road (calculated from R) Y.
Horsepower at rear tires, full load (calculated from D) Z.

These results are plotted and curves drawn as shown in Fig. 1.

The curves drawn through the plotted points are in three groups and are subject to a check. The drawbar curves for level road and full load conditions will intersect at the maximum speed of the car. The horsepower curves Y, Z will intersect at the same speed as given by the first-mentioned curves.

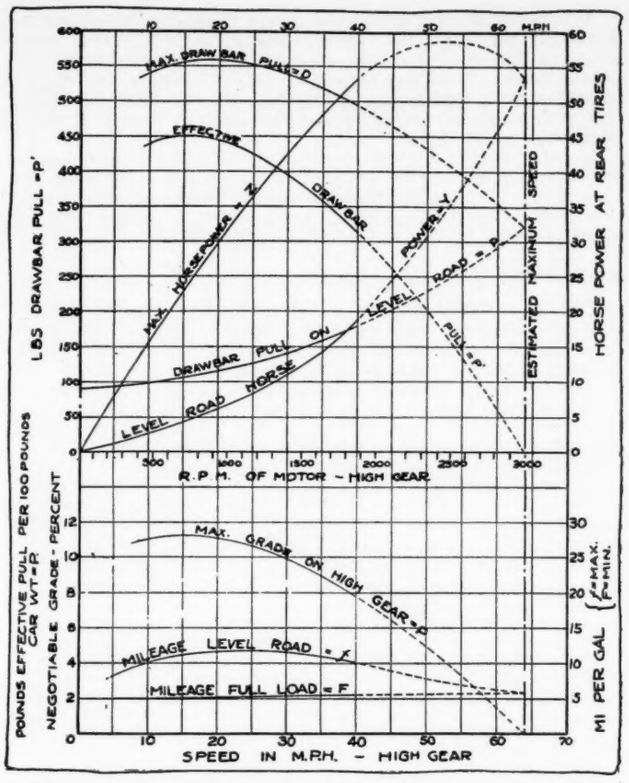

MAX. DRAW BAR PULL = D
EFFECTIVE DRAWBAR
MAX. HORSEPOWER = Z
DRAWBAR PULL ON LEVEL ROAD HORSE POWER = Y
LEVEL ROAD = R
PULL = P'
ESTIMATED MAXIMUM SPEED
LBS DRAWBAR PULL = P'
HORSE POWER AT REAR TIRES
R.P.M. OF MOTOR - HIGH GEAR
MAX. GRADE ON HIGH GEAR = G
MILEAGE LEVEL ROAD = f
MILEAGE FULL LOAD = F
POUNDS EFFECTIVE PULL PER 100 POUNDS CAR WT = P
NEGOTIABLE GRADE - PERCENT
MI PER GAL (f = MAX. F = MIN.
SPEED IN M.P.H. - HIGH GEAR

Fig. 1—Characteristic curves obtained from test in laboratory in accordance with the procedure described fully in the last paragraph in the opposite column

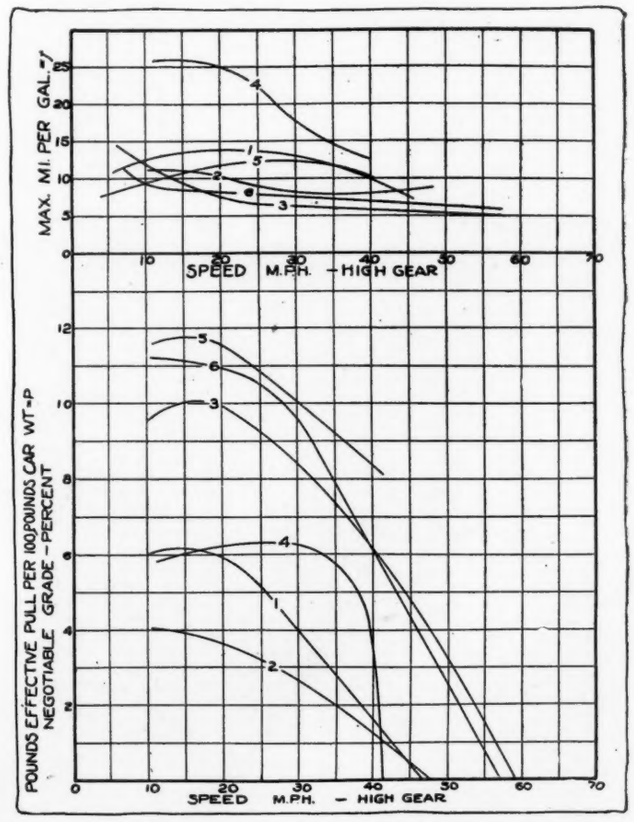

MAX. MI. PER GAL. = f
SPEED M.P.H. - HIGH GEAR
POUNDS EFFECTIVE PULL PER 100 POUNDS CAR WT = P
NEGOTIABLE GRADE - PERCENT
SPEED M.P.H. - HIGH GEAR

Fig. 2—Comparison of fuel consumption and power of six representative American cars. Cars Nos. 1 to 6 inc.

The acceleration factors are direct functions of the excess power of the car. By "excess power" is meant that total effort of the engine minus the total rolling resistance. In other words, it is the excess of pull of which the car is capable at any speed, exerted on the roadway, over and above the pull necessary to move the car against its own rolling resistance at the speed.

In brief, it is the net effective power of the car and may be conveniently expressed in pounds pull and designated P'. Concretely, P' is determined, as already noted, by subtracting the total rolling resistance from the maximum drawbar pull, as determined by the methods herein outlined.

Applicability to Road Conditions

The true value of this method of testing depends largely upon the fidelity with which its results can be duplicated on the road. To establish this, several road checks have been conducted by the authors under strictly test conditions and by others under ordinary conditions of driving. For example, a four-cylinder car was driven over a practically level course of 2,801 feet on Orange street, New Haven, a road surface corresponding closely to that of the laboratory floor. The throttle was set in various marked positions and the speed accurately noted by a stop-watch. Tests were duplicated with the car driven in both directions to eliminate the effect of any possible slight grade. The car was then placed on the test stand and the throttle opened to the same positions. The error per cent. ranged from .7 per cent. at 15 miles per hour to 5.33 per cent. at 20 miles per hour.

Disclosure of Characteristics

This method also shows to a surprising degree the relative action of certain parts of different cars. If the car is equipped with manual spark control and dash control of the carbureter, it also shows the relative skill of different drivers and the effect of these adjustments in the hands of the average user may be learned therefrom.

The test shows the performance of the car *as it is* at the moment of testing. What difference another make of tires, a different adjustment of the carbureter, or the change of any other feature would make, can be determined only by repetition of the test under the new conditions. For instance, in one case, the driver evidently desired his car to establish a reputation for fuel mileage. He was successful, but at the expense of speed, acceleration and hill-climbing ability.

Again, the rolling resistance of cars of approximately the same weight is found to vary markedly. Whether this is due to different tires or to internal friction can only be determined by substituting in one case or by more detailed investigation in the other.

The authors cannot close without recording a protest against the use of horsepower as a unit for motor car rating. Whatever may be its value in the classification of motor car engines, it seems utterly inconsistent to apply it to the performance of a vehicle. *It is the pull or push* of the tire on the road that is effective in the propulsion of a car. Witness the utter absurdity of a steam car equipped with a 20-horsepower engine, outpacing and outclimbing gas cars, the engines of which will develop upwards of 80 horsepower on the block. The steam car accomplishes this by greater and more uniform torque (or turning moment) delivered to its rear wheels through the continued and overlapping admissions of high cylinder-pressures; therefore it is clearly this torque, or turning effort, that should be recognized, and its direct and easily measurable result, drawbar pull, seems to be the logical, final unit of such measurement.

Efficiency to Replace Horsepower

Professor W. C. Marshall said that he was glad to see that these tests were carried out with different degrees of throttle opening. "And heretofore," he said, "nearly all tests have been carried out with a wide open throttle for the purpose of securing all the power possible. He asked the authors why the tests were not carried out on the road and not only on a floor 75 feet in length. He also stated that the wind resistance is not considered and that to figure it out by calculating it out by projected area is very difficult as it is difficult to find the added projected area. Another point made by Professor Marshall was that the test should have been carried on beyond 40 miles per hour in order to get an accurate curve. He made a plea against the horsepower rating of a car and stated that the deficiency of the whole combination would be more practicable.

Henry Hess, of the Hess Steel Castings Co., said that the efficiency method was impossible because too many variables entered into the subject between the introduction of the fuel in the motor and the exertion of power at the rear wheels. A. B. Brown, replying to Professor Marshall's questions, said that the tests were not carried on on the road because it was found impossible to get accurate reading on drawbar pull on a road with its unequal surface. The reason that the tests were not carried out above the speed of 40 miles an hour because after that the risks of heating because of the lack of air blasts to cool the radiator. As it was, the speed of 40 miles per hour was accompanied by considerable risk in the overheating of the motor and it was sustained only long enough to enable readings to be taken which were practically accurate.

Studebaker Multiple-Spindle Reamers Cut Costs

Specially-designed Foot-Burt twelve-spindle reamers used in Studebaker plant; rough boring twelve valve cap holes and seats in a six-cylinder casting in one operation. The rough boring is done by the sides of the cutters, while the seats are machined by the bottoms of the cutters

IN the accompanying illustration, made from a photograph taken in the machine shops of the Studebaker Corp., Detroit, some good arguments for block casting of cylinders are brought out. Not only is this advantageous construction shown to be commendable from the standpoint of rapid production, but from that of accuracy as well.

On specially-designed Foot-Burt twelve-spindle reamers such as here seen, Studebaker rough bores the twelve valve cap holes and twelve valve seats required in a six-cylinder casting at a single operation. The sides of the cutters do the rough boring, while the bottoms machine the seats. It takes approximately 3 minutes for a block to be so treated. That is, twenty can be done in an hour, or 180 in a 9-hour day on one machine.

Not only is such machinery highly important in lowering production cost, but it obviously is a most accurate way of making the holes and seats exactly the same throughout the block.

Road Improvement Costs $204,000,000

WASHINGTON, D. C., Feb. 19—According to the report of the Joint Congressional Committee on Federal Aid to Good Roads, the annual expenditures for road improvement in the United States amount to about $204,000,000. Automobile license fees amount to about $8,000,000 annually. County, township and district road bonds were voted in 1913 to the amount of $50,635,000.

Efficiency in Milling and Boring

Dodge Miller Turns Out 18 Cylinder Blocks and Heads in 1 Hour—Buda Boring Machine Does Double Work

Boring machine used by the Buda Co., Harvey, Ill. After two roughing cuts and one finishing cut the cylinder is ready for grinding. Two jigs are used, making practically a continuous operation. The boring tools are in two sets, one being used for roughing cuts and the other exclusively for finishing

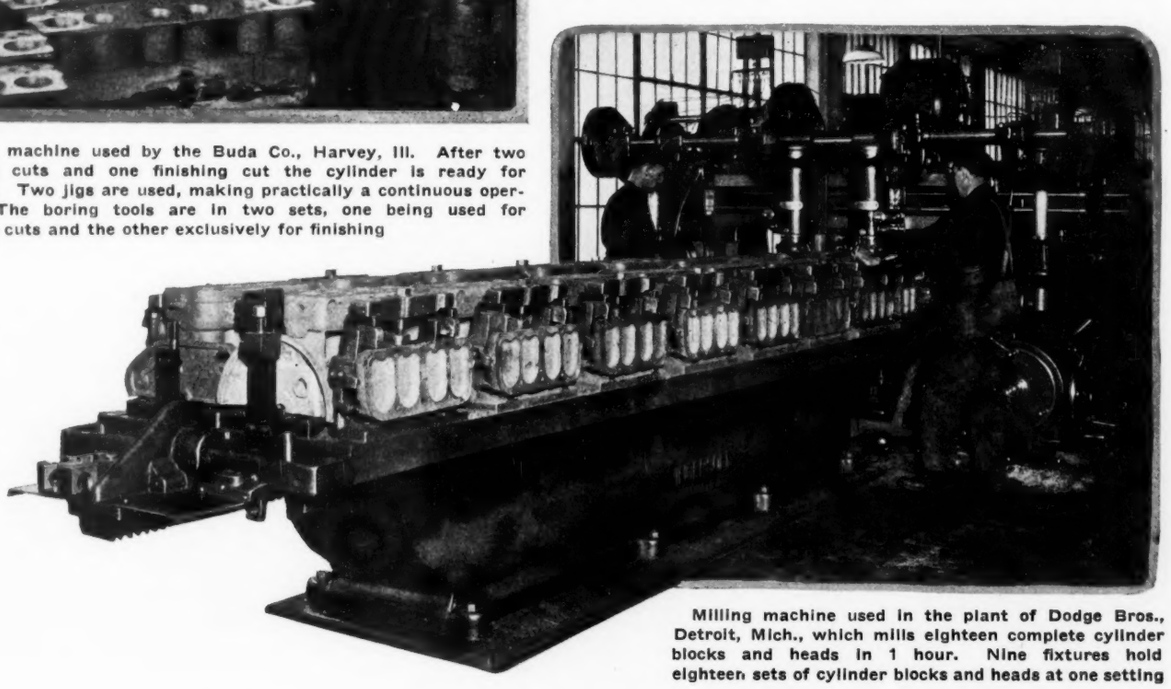
DODGE BROS. have just installed in their Detroit plant a milling machine which is unique for the amount of work it can turn out in an hour. With this special machine eighteen complete cylinder blocks and heads can be milled within the hour. Hitherto it has been universal practice to mill separately the cylinder head and the cylinder block but a considerable step in advance has been made by this machine which in one operation mills both the heads and blocks.

In carrying out the work, the method of mounting the parts to be milled may be seen from the illustration below. The cylinder heads are mounted in fixtures especially adapted to their shape located on each side of the leading table. Between the two sets of cylinder heads are two cylinder blocks held by the same fixture as that which holds the heads. Thus, nine fixtures hold eighteen sets of cylinder blocks and eighteen heads at one setting of the machine.

These eighteen sets of cylinders and heads are operated upon by four milling cutters, two of which are horizontal for the tops of the cylinder blocks and two vertical for work on the cylinder heads. The milling is a continuous operation. As soon as one pair of cylinder blocks and heads are completed, they are removed and replaced by the rough castings. In this way the table is never without a complete load at any time. When the table has run under the milling head the speed is reversed and with a full load the operation is repeated.

The milling table is 20 feet long, 42 inches wide and, exclusive of the fixtures, one loading of cylinders and cylinder heads weighs 4,000 pounds. The entire machine weighs 40,000 pounds and is driven by an individual motor.

The upper illustration shows a six-cylinder boring machine used in the plant of the Buda Co., Harvey, Ill. With this machine it is the practice to use two roughing cuts and one finishing cut. After these operations the cylinder is ready for grinding. The boring tools used are two sets of special Davis boring tools, one set being used for the roughing cuts and the second set for finishing exclusively. Two jigs are used, making practically a continuous operation, as the only time lost is that taken to index table, one jig being unloaded and loaded while the other jig is in operation. The accuracy obtained by this method is one of its chief recommendations.



Milling machine used in the plant of Dodge Bros., Detroit, Mich., which mills eighteen complete cylinder blocks and heads in 1 hour. Nine fixtures hold eighteen sets of cylinder blocks and heads at one setting

Universal Joint Losses Small

Tests Show That Under Ordinary Loads Efficiency Is Above 90 Per Cent—Installation Methods Are Important

From a Paper Presented Before the December Meeting of the American Society of Mechanical Engineers by P. F. Walker and W. J. Malcolmson

UNIVERSAL joints for use in automobiles are well above 90 per cent. efficient under all ordinary circumstances according to a paper presented by P. F. Walker and W. J. Malcolmson before the December meeting of the American Society of Mechanical Engineers.

The action of a set of two universal joints on an intermediate shaft between two parallel shafts was investigated by the authors of the paper under various angles and degrees of loads. Two sets of data were obtained, one in which the forks of the universal joints were in the same plane and the other in which the forks were at right angles to one another. It was found in all conditions that the installation with the forks at right angles to one another consumed the most power and set up vibrations due to a varying transmission of the motion between the shafts.

New Joints Used

In calculating the efficiency of the joints the conclusions were made applicable to a complete system including the two joints necessary to secure parallel operation of the main shafts. In case a knowledge of the efficiency of a single joint is desired it may be assumed without sensible error that the loss is one-half of the amount recorded for the double set and hence, the efficiency is that of the double set plus one-half the difference between that and 100 per cent. The efficiency is calculated directly from the derived values of friction loss. The curves of efficiency which are a result of the investigation are given in Fig. 1.

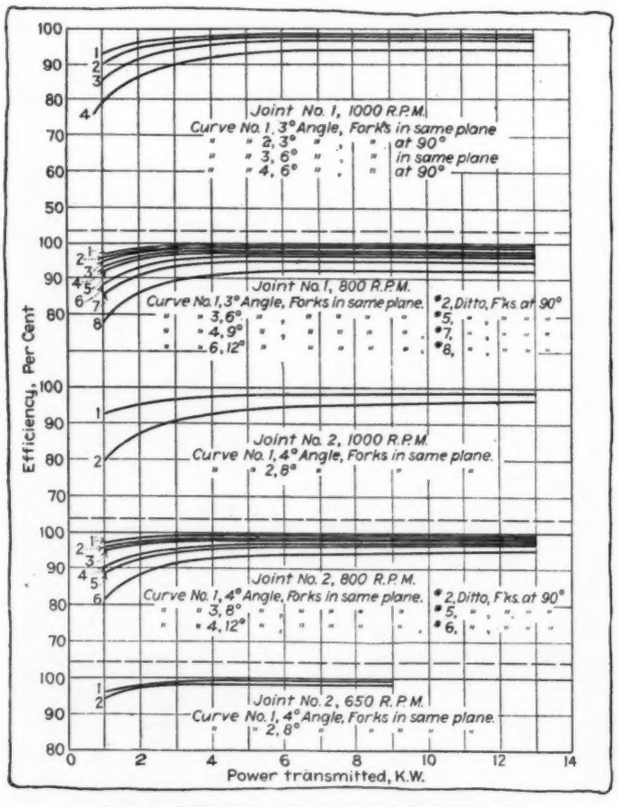

Efficiency, Per Cent
Power transmitted, K.W.
Joint No. 1, 1000 R.P.M.
Curve No. 1, 3° Angle, Forks in same plane at 90°
" " 2, 3° " " " in same plane at 90°
" " 3, 6° " " " in same plane at 90°
" " 4, 6° " " " in same plane at 90°
Joint No. 1, 800 R.P.M.
Curve No. 1, 3° Angle, Forks in same plane. *2, Ditto, Fks. at 90°
" " 3, 6° " " " " " *5, " " " "
" " 4, 9° " " " " " *7, " " " "
" " 6, 12° " " " " " *8, " " " "
Joint No. 2, 1000 R.P.M.
Curve No. 1, 4° Angle, Forks in same plane.
" " 2, 8° " " " "
Joint No. 2, 800 R.P.M.
Curve No. 1, 4° Angle, Forks in same plane. *2, Ditto, Fks. at 90°
" " 3, 8° " " " " " *5, " " " "
" " 4, 12° " " " " " *6, " " " "
Joint No. 2, 650 R.P.M.
Curve No. 1, 4° Angle, Forks in same plane.
" " 2, 8° " " " "

Fig. 1—Efficiency curves of universal joint set

An investigation of these curves shows that for universal joint sets that have the forks in the same plane the efficiency in transmitting loads of 8 kilowatts, the efficiency does not fall below 91 degrees at 800 r.p.m. for angles up as high as 12 degrees. Since the angle in a well-designed automobile, when under its designed load does not reach more than one-half this amount, the unimportance of universal joint losses is clearly brought out.

Load-Back Testing Method

The methods used by the investigators in arriving at their conclusion were such that the maximum accuracy was secured. The entire measurement in power and losses was electrical. Two electrical machines of the same size and design, one a motor and the other a generator, were connected mechanically and electrically to carry out the Puffer modification of the Kapp load-back method of testing. The motor drives the generator mechanically and the current generated by the generator is loaded back on the motor supply line. Thus, it is only necessary to replace the power lost represented by the difference in current between the original supply and that generated. Since the two machines are similar in construction, size and rating, and providing that there is no transmission loss, then the losses of one machine would be equal to half the total losses except for a small error due to the opposite effects on armature reaction in the two machines. Then, approximately, the power transmitted from the motor to the generator would be the load on the generator plus one-half of the total power supplied by the line. Thus, the transmission losses can be readily determined by a method of substitution. A wiring diagram of the electrical arrangement of the machinery of the test is given in Fig. 2.

Straight Line Losses Zero

The actual procedure in carrying out the test consisted in first running the machines with all shafts in the same straight line. The total losses of the system as a whole was then determined. Readings were then taken at different angular displacements of the shafts and similar runs were made for various speeds and loads. Experiments were made for both sets of joints, both with the forks on the intermediate shafts at 90 degrees to each other and with the forks in the same plane. Assuming, correctly, that the losses in the joint are zero for conditions of straight-line drive, with all other conditions remaining the same, the friction losses for a certain displacement of the intermediate shaft would be found by subtracting from the total losses of the system at that displacement the total losses under conditions of straight-line drive.

Owing to the vibration when the forks on the intermediate shafts were at 90 degrees to one another, it was found unsafe to operate the shafts at the larger angle. On plotting the curves with the forks so located, the data was found to be somewhat more unreliable than under the parallel condition and the exact nature of the curves could not be as accurately determined. It may be said in passing that many installations of universal joints are condemned for the sole reason that the engineers in charge have neglected to place the forks in parallel planes. A sample of the readings which were taken follows:

	Angle of Deflection	Line Current, Amperes	Generator Load, Amperes	Voltage, Volts	Load Transmitted, Watts	Loss, Watts
Forks in same plane..	0	58.1	100	65.8	7444	3820
	3	58.1	100	65.9	7450	3835
	6	58.6	100	66.3	7490	3880
Forks at 90 degrees..	0	58.0	100	66.2	7480	3835
	3	58.3	100	66.7	7530	3895
	6	60.9	100	65.7	7430	4000

The constancy in the efficiency fraction indicates a constant value of the coefficient of friction on the joint journals, since the bearing pressures are proportional to power transmitted when speed remains constant. Under conditions of service, questions of lubrication and protection from dust are important. A downward tendency in efficiency under large loads doubtless marks the point where bearing pressures on the journals make lubrication imperfect. The rocking motions of the journals tend to squeeze out the oil.

—

The Correct Propeller Shaft Layout

IN a paper presented to the S. A. E. for its winter meeting C. W. Spicer, Spicer Mfg. Co., Plainfield, N. J., gave the results from Messrs. Walker & Malcolmson's researches. He went on to state that the ideal layout is as shown in Fig. 4 because the total angularity is then divided between the two couplings. This is well enough so far as the mere joint efficiency is concerned but it introduces another factor which is worthy of consideration.

When a shaft is running at a steady speed, if it drives another shaft at an angle with it, the connection being by universal joint, then the second shaft runs at the same number of revolutions per minute, of course, but it does not run steadily. Owing to the relative motion of the inner and outer parts of the joint the driven shaft either lags behind the driver or hastens to catch it up,—so to speak; the actual effect being that the speed of revolution of the driven shaft varies from a maximum to a minimum each half revolution. To take an actual case, imagine a motor running steadily at 1,000 r.p.m. then if the propeller shaft is making an angle of ten degrees with the crankshaft, the speed of the propeller shaft will vary from a minimum of 984 r.p.m. up to a maximum of 1,016 r.p.m. If there is only one joint on the transmission then the bevel pinion will perforce vary likewise.

Now, if the gear ratio be four to one then the force applied to the road wheel will have four maxima and four minima per road wheel revolution, and its speed obviously cannot vary so rapidly it having the whole mass of the car to accelerate or decelerate for every change in its rotational velocity. Therefore the effect will be reversed; that is to say the mass of the car acting through the road wheel will

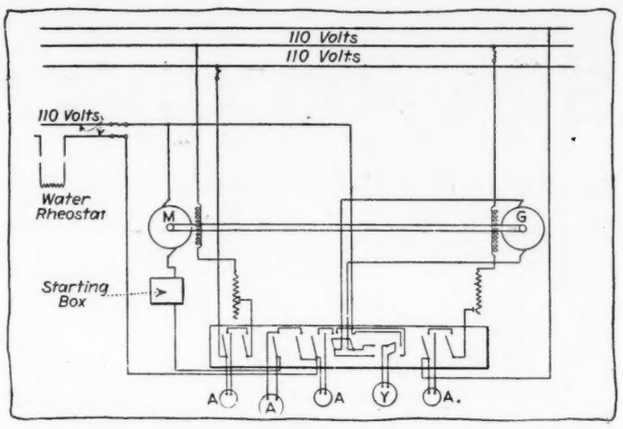


Fig. 2—Wiring diagram showing layout of testing apparatus

force the bevel pinion to run steadily. As one shaft or the other *must* vary this means that the crankshaft and flywheel will have to do so, and this in turn means that the pressure on the teeth of the bevels will be continually fluctuating with a fairly rapid vibration.

Of course the flywheel is already fluctuating and, in an ordinary four-cylinder motor, it is usually assumed that the variation is in the nature of four per cent. This means that, if the average crankshaft movement is equivalent to 1,000 r.p.m., each explosion will accelerate the flywheel to a rate corresponding to 1,040 r.p.m. there being a slow falling off in velocity and then a rapid rise with the next explosion.

This variation with a four cylinder motor will be of twice the frequency of that variation due to the universal joint, but the two variations will "beat" like sound waves in certain chords, the effect being to produce a variation of slower pitch with a maximum of 1,056 and minimum of 944 r.p.m. for each crankshaft revolution.

Since pressures throughout the transmission are always subject to flywheel variation and to much larger variations due to inequalities in road surface it is obvious that the question is not of really prime importance, but the statement of the facts goes to prove that the use of a single universal joint may nullify the greater smoothness in running which always is obtainable by a slight increase in flywheel weight.

To remove all fluctuation due to universal joints it is only necessary to use two instead of one, keeping the axis of the bevel pinion shaft and the axis of the crankshaft always parallel, as shown in Fig. 3. Then one joint is being bent up while the other is being bent down, so to speak. When this is the case the propeller shaft runs irregularly, but the second joint being bent the opposite way to the first cancels out the variation.

This may seem a very small matter indeed, but the wonderful smoothness of the modern car has only been obtained by attention to multitudes of such insignificant details. In the setting shown in illustration, Fig. 4, the second joint simply doubles any variation due to the first joint. It would therefore, from the point of view of steadiness, be better to use the longest possible torque rod, if not even a parallel motion link as has been done on some cars.

Since it is only fair to look at the other side of the question Mr. Spicer is incontestable in that his design will cause less loss of power in the joints themselves but since, as he most ably shows, this loss is in no case worth considering it being so very small, it seems unlikely that the gain in efficiency obtained by his arrangement is worth its complementary drawback.

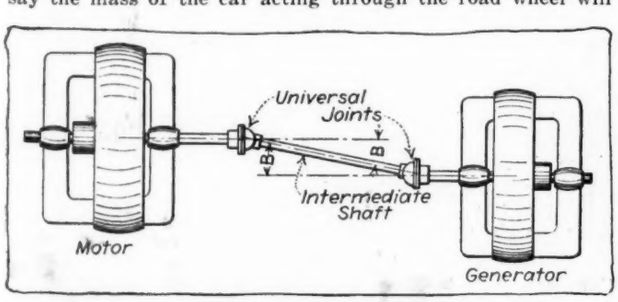


Fig. 3—Mechanical arrangement of testing apparatus

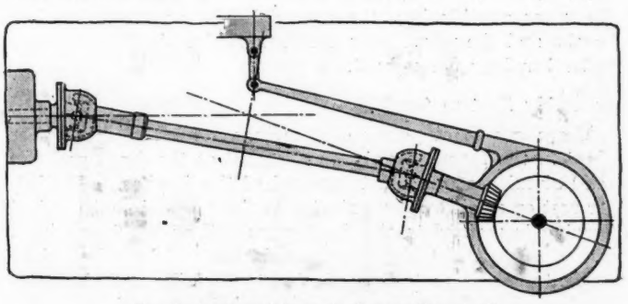
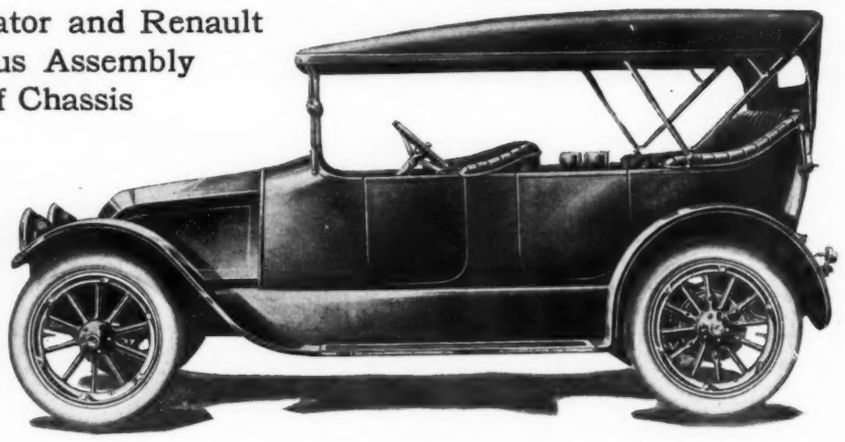


Fig. 4—Incorrect layout of propeller shaft

Stewart Six—A New Chassis

New Car Has Dash Radiator and Renault Type Hood—Ingenious Assembly System Feature of Chassis



The new six-cylinder Stewart touring car. Radiator is mounted at dash

AS an example of to how great an extent it is possible to introduce individuality when designing a chassis to be made up chiefly from well known units, the new Stewart six made by the Stewart Motor Corp., Buffalo, N. Y., must take a prominent place. The company has been making trucks for several years and has a number upon the road but it is only during the last 2 weeks that it has entered the passenger car field. It is not the idea to scheme for a large output, but rather to employ a motor, gearset and axle of high quality and keep the price of the complete car down to a moderate figure by eliminating all unnecessary work in the process of assembly.

Figuring on the basis that the expensive part of an automobile is the labor, they have aimed to make one human operation cover as wide a range as possible while the parts that have to be handled are in no case heavy or awkward, with the solitary exception of the motor itself. Since this cannot be made a lighter part the task of handling it is rendered as easy as possible by the method employed for placing it in the frame, and there are no other parts whatever that require alignment with the power plant.

The Power Plant

The motor is a six-cylinder Continental rated at 44 horsepower with bore and stroke 3 1-2 by 5 inches, giving a displacement volume of 288.6 cubic inches, there is nothing abnormal in the engine save that the water header is reversed in direction on account of the radiator position. For starting and lighting the Westinghouse two-unit system is used, the motor having the usual flywheel drive. The carbureter is a Zenith, the hot air supply being taken through a pipe passing across the top of the cylinder jacket, and gasoline feed is by Stewart vacuum apparatus. Of course, the Westinghouse outfit takes care of the ignition, and there is no spark lever, the only motor control consisting of a pedal accelerator and a hand lever on the steering wheel for setting the idling position.

A three-speed Brown-Lipe gearset is bolted to the motor by a bell housing, and this carries the Raybestos and steel multiple-disk clutch, but the pedal gear is not attached to the unit power plant, being a separate assembly unit. Both the axles are Timken, the rear drive being through spiral bevels, and the wheel hubs are furnished with Timken taper roller bearings throughout.

Assembly System for Motor

There are three points of attachment for the unit power plant in the frame, a swiveling bracket at the front and two solid aluminum arms just forward of the flywheel. The latter rest on small brackets riveted to the frame, but the swivel housing is secured to the front cross rail of the frame by a couple of bolts. This cross rail is itself detachable, since separate corner plates are riveted to the sills and the cross rail attached thereto by a couple of bolts at each end. To insert the power plant in the frame the front cross rail is bolted to the motor and the unit then slung into place. As soon as the cross rail is secured the rear supporting arms of the crankcase take up their natural position on the brackets, and it is then only necessary to drill the four bolt holes in the frame to suit those already in the motor bearers. Similarly, should it be at any time desired to remove the motor, it can be taken out very easily without disturbing any other part, by removing the front cross rail and then pulling the power plant forward. It is not even necessary to interfere with the radiator, since the gear shift lever comes away with the lid of the transmission, and the hand brake lever is not attached to the power plant.

There is a short shaft with a single, wide bracket support, carrying both clutch and brake pedals and the throttle pedal also. This is secured to the middle cross rail of the frame by a couple of bolts only and, when attached, it remains only to connect the brake rod and the right pedal and a short drag link between the clutch pedal and the clutch operating lever that projects from the transmission. It will be seen that there is no need for alignment of any kind. The hand brake lever is made up with its quadrant and ratchet on a separate bracket also bolted to the middle cross rail.

Cantilever Springs Have Special Brackets

The attachment of the 50-inch cantilever springs, made by the Detroit Steel Products Co., is such that there is no twisting stress imposed upon the side rails of the frame, and the springs are in the best possible condition for transmitting the drive. The first operation in this assembly is to rivet a couple of brackets to the side rails, and these are the only parts of the chassis that need to be in line. A stout tube passing right across the frame is secured in these brackets with the ends projecting on either side of the frame, and the spring center clips are slid on the ends of the tube, being retained by nuts on the extreme ends thereof. Thus the spring clips are free to rock on the tube ends, but the cross tube ties the springs together and equalizes stresses on either side.

Further, the cross tube is not only used as a spring mounting, but is also the base for the brake assembly and carries the swinging bracket of the pressed steel torque stay. For mounting the compensating mechanism of the brakes there are three brackets of a three-armed form: each has a detachable cap on one arm and this part is drilled out to

suit the cross tube. The bracket which has the middle position on the tube has each of the other two arms drilled out to suit the cross rods to which the brake operating levers are attached, and the two end brackets are drilled similarly, only the drill is not run right through, so the end brackets keep the rods in place. There is no compensation for the hand brake, since the cross rod is solid and has three levers, one linked to the hand lever and the other two to the expanding brakes. For the pedal brake the cross rod is in two parts, the junction being located inside the midmost bracket and a compensating beam introduced in the pull link from the pedal. Self-lubricating bushings are used for the bearings throughout this assembly.

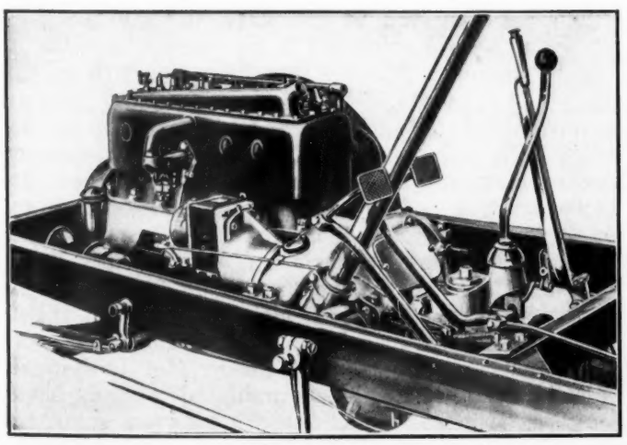
The steering gear is attached to the frame by a pair of bolts, and is independent of the power plant, while the bracket is such that the angle of rake is fixed by the toeboard bracket which means that it would be possible to alter the rake to suit special body styles or even individuals, though a regular adjustment is not provided.

Add to the steering gear the brackets for the front springs and for the front ends of the cantilevers, and we have itemized every frame attachment for chassis erection.

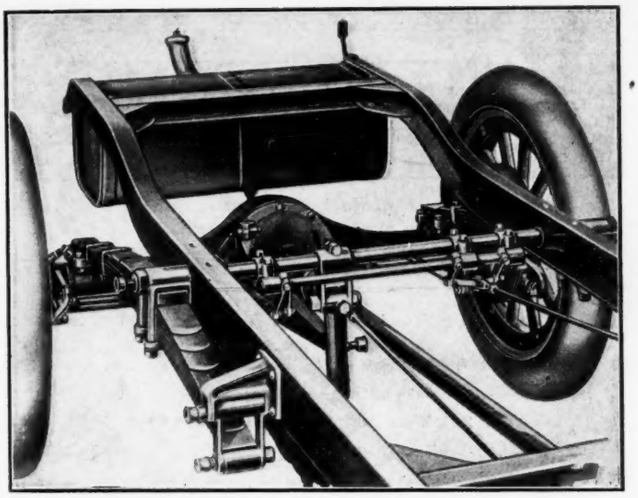
The radiator is made up in unit with the cowl and is a Fedder honeycomb with a fan behind it mounted on a bracket extending upward from the clutch case cover. This fan is belt driven from a pulley running in a swinging bracket located upon a pin projecting rearwards from the bell-housing portion of the transmission. On the same spindle as this pulley is a fiber-faced wheel that is kept bearing against the flywheel of the motor by a light spring, so providing the drive for the fan belt. The latter is adjustable for tension by a slide on the fan supporting attachment. All air is driven down beneath the footboards and there is sufficient gap behind the radiator to give insulation from the temperature of the latter, a point of some importance in summer with a dashboard radiator location.

Aluminum Body and High-Class Fittings

Money has not been spared on the body, which is designed to give ample room for its seven passengers, and the detail is cared for especially well. For example, the additional seats fold away into the back of the front seat, where they are concealed completely, there is an exhaust-heated radiator to increase the comfort of the tonneau passengers, and the upholstery is deeply padded. Owing to the great width of the seats there is plenty of free space between the driver and front passenger, which can accommodate a child if desired, or there is an optional body style with divided front seats. All the gauges and instruments are located in the dash in positions convenient for the driver, and the side lights are imbedded in the cowl. The wiring is arranged with all fuses hinged into the cowl board and junction boxes are placed in accessible positions.



Six-cylinder Continental block motor, with 3 1-2-inch bore and 5-inch stroke and rated at 44 horsepower, which is used in the Stewart six. Note clean design and accessibility



Rear construction of the Stewart six. Note special brackets for attachment of cantilever springs. The cross tube ties the springs together and equalizes stresses on either side

Turning to the specification details other than those mentioned; the wheelbase is 127 inches and the tread 56. Tires are 34 by 4½ inches with nonskid in the rear and plain tread in front. Firestone demountable rims are furnished with one extra rim. Gear ratios are 4.45, 7.55 and 10.58 to 1 respectively. The price fully equipped is $1,950.

During a short run in the car through the now somewhat rough streets of Buffalo the cantilever springs gave great ease in taking street car crossings some 6 or 8 inches below the road level, while there was very little roll on corners. The body, doubtless due to the aluminum construction, was free from any suggestion of drumming noise and all portions of the control operated smoothly.

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United Trucks Appear at Grand Rapids

GRAND RAPIDS, MICH., Feb. 20—The annual automobile show which came to a close today was the best attended in the history of local shows. There were on display thirty-six different makes of passenger cars and eight of commercial vehicles. The exhibitors totaled sixty of which thirty-one showed motor cars.

There was shown for the first time the line of trucks of the United Motor Truck Co., a new local concern. The three models made are a 1 1-2-, a 3- and a 5-ton truck. All have Continental four-cylinder power plants with the cylinders cast in pairs. On the smaller truck the bore and stroke are 4 1-8 by 5 1-4 and on the two other models 4 1-2 by 5 1-2. All have Stromberg carbureters, Eisemann ignition, multiple disk clutches, Mayo honeycomb radiators, splash lubrication, Gemmer steering gears, left drive and center control, Timken front and Timken-David Brown floating rear axles.

The worm-driven model, the 1 1-2-ton type, sells at $2,150. The 3-ton truck with chain drive is sold at $2,750 and with worm-drive at $2,950. The 5-ton model is listed at $3,400 with chain-drive.

The wheelbase of the smaller truck is 148 inches. The other two models have a standard wheelbase of 144 inches, but at an additional cost of $50 a 120- or a 168-inch chassis is furnished, or a 192- or 216-inch chassis if $100 is added.

The tires on the 1 1-2-ton truck are 34 by 4 front and 36 by 4 dual rear; on the 3-ton model 36 by 5 front and 36 by 5 dual rear and on the 5-ton truck 36 by 5 front and 40 by 6 dual rear.

The Automobile

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Reforming the Farmer

WITH grain crops worth approximately $2,000,000,000 grown in eight states in the Mississippi valley this year, and with even better crop prospects in these states for next season, the value of the farmer as a consuming factor in automobiles for the present season and also next season is apparent. In some of these states the farmer purchased over 60 per cent. of the cars marketed in 1914. In 1915 he will, according to conservative estimates, purchase upwards of 70 per cent. of those sold.

In several of these states the farmer is buying more expensive cars as year succeeds year. After all he is a human being, susceptible to the same likes and dislikes as his city brother. He started with the cheapest car, but today many are buying more expensive machines. The farmer is an experienced buyer of machinery. From the day he settled on his land he has been a purchaser of plows, harrows, disks, binders, wagons, gasoline engines and other necessities. He has learned how to care for machines and how they are abused. To him the automobile is another machine. He wants to buy it as he bought his binder, some cash down and the rest on notes. He wants to run it as he runs other machines, in fact, the car is merely an addition to his machinery equipment. He is a careful operator, one who frequently inspects to avoid breakdowns. There is one aspect of the car he has not realized, that is occasional washing; at present he uses the car as he does his binder, never washed from purchase until finally laid aside.

The more aggressive automobile dealers are reforming the farmer in some few respects. They are changing him from a credit buyer to a cash buyer in a few sections. Instead of carrying his repair and gasoline accounts for months they are getting him to pay in advance in a few sections and in other sections at time of delivery. Thus does the automobile give promise of working a good for the farmer that was deemed impossible.

A Chicago Section?

IN ratio of population Chicago has never been a strong center for the manufacture of automobiles or automobile accessories, with the possible exception of the carbureter field, in which the city has been well represented for years. The number of automobile engineers per unit of population is considerably lower than in Detroit, Indianapolis, Cleveland or perhaps New York. In spite of this handicap why not a Chicago section of the Society of Automobile Engineers?

The second metropolitan city of the land should be represented in the automobile industry by such a section. There are enough engineers within the confines of the Windy City to make a section possible; and then it can draw on Kenosha, Racine and Milwaukee, Moline, Rock Island and Davenport. Should monthly meetings prove too burdensome then quarterly ones could be handled to advantage.

Chicago has two enterprising technical schools, which draw from the enormous agricultural territory of the Mississippi valley. Many of the students could be interested in the work of such a section. There is a possibility for a large student attendance. The city by virtue of these institutions is well qualified to conduct technical tests, in fact, there is not any reason why Chicago should not launch its section before the end of the present year.

The Jitney

EASTWARD is coming the jitney movement. Conceived beyond the Rockies, it is invading city after city, and in the wake of each invasion grows up a stronger spirit in the masses in favor of the automobile. Already the jitney has written its story in the hearts of thousands of working people; a story which tells of quicker transportation to the office than was possible with established means of transportation. But the jitney has gone further. It has carried tens of thousands, who never expected to enjoy the latest means of locomotion, the automobile. These people have experienced what others have talked of, namely, that the automobile is not so much a luxury as a necessity. Never before did these masses believe it; today they are convinced of it. A great missionary movement for greater individual efficiency has already been stimulated; already have many experienced the difference between going to work in a poorly ventilated trolley car and riding in the open air on a quiet motor car. The jitney is a body stimulus, it is a mental stimulus.

H. Ward Leonard Dies Suddenly

Prominent Inventor Had Done Much for Automobile, Railway and Other Industries in the Electrical Field

NEW YORK CITY, Feb. 19—H. Ward Leonard, electrical engineer and founder of the Ward Leonard Mfg. Co., Bronxville, N. Y., died suddenly of apoplexy last night at the Hotel Astor. Mr. Leonard, who was a director of the American Institute of Electrical Engineers, was at the hotel with his sister attending the banquet of the institute when he was suddenly stricken and died 15 minutes later in one of the reception parlors of the hotel.

Mr. Leonard was 54 years old and his death brings to an untimely close a career which was of the greatest value to the automobile and other industries covered by the wide field of his electrical inventions. For years he has been recognized as one of the country's foremost authorities on electrical apparatus, especially that covering different forms of control mechanism. In his work he has been closely associated with Thomas Edison and Sir Oliver Lodge. It is stated that he had over 100 patents actually in commercial use at the time of his death.

The Late H. Ward Leonard

During the past few years Mr. Leonard has not taken an interest in the details of the Ward Leonard company but has concentrated his attention on the business created by his various patents. He was a strong figure in the patent world and the victor in many important litigations. His patent activities, however, did not prevent him from acting as consulting engineer for his company and he was always accessible for consultation regarding the important affairs of the business.

Mr. Leonard first became interested in the automobile industry in 1895 during a visit to France. On his return from this country he had shipped to him fifty foreign motors which he incorporated in a car of his own manufactured at the Bronxville plant. That these cars were successful is shown by their endurance runs won during the years of 1898 and 1899, but in 1901 the project was abandoned, owing to difficulties in securing material. Mr. Leonard never ceased to have a keen interest in the development of the automobile, however, and his opportunity to make his electrical genius of great use came with the introduction of electric starting and lighting. The Ward Leonard system of battery charging and regulation in which the basic idea has been to maintain a constant amperage output has been of special value.

Mr. Leonard came into prominence as an electrical engineer at the age of 23, a year after his graduation from the Massachusetts Institute of Technology, when he was made a member of Mr. Edison's staff of four engineers engaged in the Edison Central Station system. At 26 he was made general superintendent of the Western Electric Light Co., Chicago. In 1889 Mr. Leonard was made general manager of the combined Edison interests of the United States and Canada. Two years later he resigned this position to found a company of his own, the Ward Leonard Mfg. Co.

In this factory the manufacture of control systems for electric lighting and starting systems, for which the company is best known to American automobile manufacturing interests, is only a small part of the business. A broad field is covered based largely upon the inventions of the founder which embrace electric lighting systems for automobiles and railroad trains, electric distributing systems, electrically driven reversible rolling mills, electric mine hoists, locomotives, elevators, gasoline-electric transmission systems and various other automatic electrical control features.

The first inventive work of importance engaged in by Mr. Leonard was in connection with an electric lighting system for railway cars. In 1888 he put this system into actual use by installing it upon two trains running between Chicago and Minneapolis. This system with but few changes is still in use and has been installed on railroads throughout the world.

In 1891, he completed what was probably the most important invention of his life. This is the Ward Leonard system of speed control. By this system it is possible to secure a smooth speed control; to almost instantly reverse the motor speed from maximum in one direction to maximum in the opposite direction while at the same time minimizing the energy required to perform the work. The Otis Elevator Co. adopted this for use on its elevators and the battleship Brooklyn was fitted with it for turret control in the Spanish-American war. This worked out so well that it has been practically universally adopted by the U. S. Navy.

Mr. Leonard has been an important contributor to papers devoted to electrical and railway engineering. He has frequently delivered papers before the American Institute of Electrical Engineers, particularly on railroad work. For electrical research work the Franklin Institute of Philadelphia in 1903 conferred upon him the John Scott medal. He was also awarded the Gold Medal at the Paris Exposition in 1900 and at the St. Louis Exposition in 1904.

One of the connections he prized most highly was his membership in the Inventors' Guild. The society is fashioned somewhat after the French Academy and none but men who have become noted through important inventive achievement are eligible. Mr. Leonard has been president of the society.

He has been a vice-president and also a manager of the American Institute of Electrical Engineers which he joined in 1887. He was a life member of that organization. He was also a member of several social organizations including

the Union League Club, of New York, the Inventors League, the Engineers Club, the Clove Valley Rod and Gun Club, New York Electrical Society, the Technology Club of New York and the Scarsdale Golf Club. He was a director of the Mount Morris Bank of New York, president of the Sagamore Development Co. and has been president of the village of Bronxville, a beautiful suburb of New York City where he resided in Lawrence Park.

Mr. Leonard was born in Cincinnati, O., February 8, 1861. He is the descendant of a long line of Americans, three of his forebears having lived in this country prior to 1639. These were John Alden, Solomon Leonard and William Ward. John Alden is the one of whom Longfellow speaks so frequently in his poems of the times of Miles Standish. Alden, as is well known, came to this country in the Mayflower. Solomon Leonard came to this country in 1629 and in 1642 along with John Alden and Miles Standish founded Duxbury, the first settlement out of Plymouth. William Ward came to America in 1639.

One of Mr. Leonard's ancestors founded the steel industry of America in Taunton, Mass., in 1651 and his great-great grandfather was General Artemus Ward, who was made commander in chief of the forces raised by Massachusetts for the defense of the colonies. When the troops for all the thirteen colonies were merged under General Washington, Artemus Ward was made second in command. He was the first major general in the American Army.

Mr. Leonard, in spite of his great business activity, found time to devote himself to his wife and his beautiful suburban home. He married Miss Carolyn Good of New York City in 1895. Both were fond of entertaining and both enjoyed outdoor sports and it was their custom to make an annual fishing and hunting visit to Camp Chippewa, their summer home at Pointe au Baril, Georgian Bay, Ont.

Hewitt Bill Would Double New York Fees—Other Bills Before State Legislature

NEW YORK CITY, Feb. 18—If provisions of a bill introduced in the New York legislature by Senator Hewitt of Cayuga are enacted into law, the registration fees for passenger vehicles will be doubled and in addition a heavy burden will be placed on the operators of commercial vehicles and passenger buses. Here are the fees advocated by the Hewitt measure as compared with those at present in force:

Passenger Cars

Horsepower Rating	Hewitt	Horsepower Rating	Present
25 or less	$10	25 or less	$5
25 to 40	20	25 to 35	10
40 to 50	30	35 to 50	15
50 and over	50	50 and over	25
Electric	10	Electric	5

Commercial Vehicles

25 to 40 and weighing over 4,000 lbs	$30	For both gasoline and electric cars, irrespective of horsepower rating or capacity	$5
Electric weighing over 4,000 lbs	$20		

$5 additional for each passenger-carrying capacity and $25 additional for each ton of capacity in baggage or freight for motor vehicle operated as bus.

In addition to this measure, which is probably the most drastic of all those at present in the legislative mill, there are some nineteen others, the most important of which are as follows:

Assembly bill No. 19 introduced by Kramer, which provides that all provisions now applying to chauffeurs be made applicable to every operator of a motor vehicle; that is, license examination, badge, etc.

Senate bill No. 180 introduced by Simpson, which amends the Penal law in relation to injuring or removing road signs or danger signs on the highway and makes the displaying of advertising matter on the highway a misdemeanor, neither offense being punishable by a fine of not less than $5 nor more than $25 or by imprisonment for not more than ten days or by both.

Senate bill No. 332, introduced by Cristman, which would transfer to the state commissioner of highways the power and duties of the secretary of state in relation to motor vehicles.

Assembly bill No. 47, introduced by Flamman, which provides that every operator of a motor vehicle must pass an examination and carry out all the provisions now applicable to chauffeurs and obtain a license at a cost of $2; no person under 18 years shall be licensed.

Assembly bill No. 575, introduced by Pratt, which also provides for the transfer of the duties of the secretary of state in relation to motor vehicles to the state highway commission.

Wants to Change Arizona License Law

PHOENIX, ARIZ., Feb. 19—Secretary of State Sidney P. Osborn, in his annual report, takes issue with the Arizona tax commissioners, who made the assertion in their report that the registration fees for motor vehicles in this state are too low.

In arriving at their conclusion the commissioners took the California law as a basis. There the registration fee for machines under 25 horsepower is $10, and in Arizona it is $5. Osborn draws attention to the fact that California has issued $18,000,000 worth of bonds for a state highway system, and states that the Golden State motorists receive far more for their money than do the automobilists of Arizona. "The depreciation of a car in this state, because of the wear and tear occasioned by the miserable roads, is conservatively estimated to be 50 per cent. greater than in California, but under the present circumstances to raise the license fee would practically amount to extortion and would be unwise in the extreme," he says.

Osborn urges that the S. A. E. rating be abandoned and some more equitable system adopted for determining the horsepower of a car. Another recommendation is that the upper half of the glass in all automobile headlights be frosted.

At present the secretary is required to issue a chauffeur's license to anyone who can pay $5. He recommends that this license be abolished or that applicants be compelled to pass a practical and technical examination. He asks the Legislature to grant him authority to revoke a chauffeur's license for cause.

INDIANAPOLIS, IND., Feb. 19—A bill taking the collection of the state motor tax out of the hands of the secretary of state and placing it in the hands of the county auditors has been passed by the House of the Indiana legislature and it is believed it will become a law. The purpose is to reduce the cost of collection. The state is to sell the license tags to the counties at cost. The county auditors are to be permitted to charge a notary fee of 25 cents for issuing licenses in each instance. All beyond the cost of the tags is to be retained by the counties for good roads work. It now costs the state $40,000 annually to collect the license fees and all above this cost goes to the counties for good roads.

AUGUSTA, ME., Feb. 20—If the bill introduced in the State Senate this week becomes a law the Maine Highway Commission will be legislated out of office and the whole law of 1913 that meant so much for Maine will be repealed. The petition provides for other methods of handling the funds of the state in the building of roads.

LANSING, MICH., Feb. 19—Intoxicated automobile drivers are to be sent to jail for 1 year, or fined $250, or given both penalties if a bill presented by Representative George W. Miller, is adopted by the House. Any person who just before starting to drive takes a drink of any intoxicant, or who takes a drink while driving will be considered intoxicated.

LANSING, MICH., Feb. 19—State Senator Paul, of Kent county, has introduced a bill to compel automobile manufacturers to provide all motor cars with a safety device to prevent internal combustion engines from back-firing and thus cause people to be hurt while cranking their automobiles.

Delaware Makes Changes in Automobile Law

WILMINGTON, DEL., Feb. 19—Acts which have just been passed by the Legislature make the following changes in the Delaware automobile law:

1. The secretary of state shall revoke the license of any person

convicted of operating a motor vehicle while under the influence of liquor.

2. The secretary of state is empowered to revoke the license of any one upon three convictions of the automobile law in any one period of 12 months.

3. All magistrates are required to notify the secretary of state of all convictions under the automobile law.

4. Motor vehicles operated by a foreign corporation, firm or co-partnership must carry Delaware tags, except foreign dealers or manufacturers, where reciprocity is given according to the non-resident reciprocity clause.

5. The speed limit is increased from 12 to 15 miles an hour in cities and towns, slowing up at intersections of streets. On highways in open country the speed limit is increased from 20 to 25 miles an hour.

6. Motorcycles are required to carry a new style of tag and no one is permitted to operate a motorcycle except the one who obtains the registration.

7. Defining the family operator's license as including a husband, wife, son, daughter or other relative or person who lives within the house or domicile of the owner, but does not include a servant, hired help or professional operator.

8. Prohibiting dealers from operating more than one car at the same time under the same registration number.

9. Officials of fire departments are given the same exemption as the fire engines and apparatus when responding to an alarm of fire.

10. Only official tags issued by the state can be used on any motor vehicle or motorcycle.

Senate Passes Compensation Law Amendment

ALBANY, N. Y., Feb. 22—An amendment to the workmen's compensation law, allowing an employer in this state to settle an award with an injured workman was passed tonight by the Senate. The bill now goes to the Assembly.

By the terms of the direct settlement clause, employers and employes may settle their cases without interference on the part of the compensation commission if the workingman is satisfied. If he is dissatisfied, he may appeal an injury case to the commission after 24 days. Sixty days after death his family may appeal if they do not like the settlement offered.

All Ohio Vehicles Must Carry Lights

COLUMBUS, O., Feb. 23—A law has been passed by the Ohio General Assembly compelling all vehicles, both motor-driven and horse-drawn, to carry lights, visible from in front and behind when operated on all of the public highways and streets of the state after sundown.

COLUMBUS, O., Feb. 23—The Ohio Senate has passed a bill, dividing chauffeurs into two classes, making a stiffer examination for one class as compared to that given the other class. The minimum age limit for operating cars is 16 years.

Representative Deaton has introduced a bill in the Ohio Legislature providing for the suspension of the owners' license for 60 days upon being convicted of violating the speed limit; a suspension of a year for the second offense and permanent suspension for any subsequent offense. The new measure makes no distinction between a chauffeur and an owner. This bill will be opposed by the Ohio State Automobile Assn. and the various local clubs in the state.

Indiana S. A. E. Thinks Eight a Fixture

Animated Discussion Over Designing and Manufacturing Problems —Predict 12-Cylinder

INDIANAPOLIS, IND., Feb. 22—The eight-cylinder motor was the subject discussed at the February meeting of the Indiana section of the Society of Automobile Engineers. The meeting was held last Tuesday night at the Claypool hotel in this city and the principal speaker was J. H. Heinze, chief engineer for the Northway Motor and Mfg. Co.

There was the widest latitude in the discussion, much of it centering around whether or not the eight-cylinder car has come to stay. Lon R. Smith was chairman of the meeting and opened by stating that George Schebler of this city is again working on a twelve-cylinder motor.

It was the opinion of Mr. Heinze that the eight has come to stay, but he did not believe it has reached perfection. He urged against the building of cheap eights, saying it would do the industry much harm. Ultimately he thought it might be possible to produce eights as cheap or cheaper than fours. Whether they will prove as economical to the public from an operating standpoint is a question time only can settle, he said.

Mr. Heinze said there are several problems confronting engineers in the manufacture of eights. One, he said, is that of lubrication. Advantages he saw in eights included general construction, cost of manufacture, less strain on parts, ease of riding and elimination of vibration.

Manufacturers, Mr. Heinze pointed out, are building successful sixes and there is no reason why they cannot make successful eights. He said engineers will not stop with eight cylinders, but will go on to twelve, and possibly more.

Charles Crawford, engineer for the Cole Motor Car Co., said there is a demand for eights, and pointed to an order for 100 Cole eights from Buffalo in answer to a statement by George Dickson of the National Motor Vehicle Co. that he could not see a demand for eights. Howard Marmon, of the Nordyke and Marmon Co., thought it might be a year before it is known definitely whether or not the eight has come to stay. The Marmon company, some years ago, built two or three eights for experimental purposes.

Gasoline-Electric Committee to Report

NEW YORK CITY, Feb. 24—The meeting of the Metropolitan section of the S. A. E. will be held Thursday evening, February 25. The report of the gasoline-electric committee, which will be submitted by David Beecroft, represents a great amount of research and a good representation of what can be done by section research committees. In addition to this report the constitution of the section as drawn up by the committee on constitutional amendment, comprised of Messrs. R. McA. Lloyd, J. E. Schipper and A. B. Cumner, will be heard. This is a model constitution proposed by the council of the Society for all sections.

The Indiana section of the Society of Automobile Engineers discussing eight-cylinder motors at the Claypool hotel, Indianapolis, February 16

300 Armored Trucks Ordered

Morton Four Wheel Drive Tractors for Use of Russia—Order Represents $1,500,000

YORK, PA., Feb. 20—An order for 300 armored motor trucks totaling $1,500,000 has been placed by the Russian Government with the Morton Truck and Tractor Co., Harrisburg. Samuel Morton, a member of the firm, arrived in London, England, this week and with R. L. Morton, who is also abroad, will represent the Harrisburg company in giving demonstrations and securing contracts for the allied armies.

W. S. Morton, general manager of the company, in speaking of the Russian contract this week, stated that the work will require at least 250 additional skilled mechanics and that with these extra facilities about fifty trucks a month will be shipped to Russia. The work will commence as soon as the amount covering the order is deposited in a New York bank by the Russian government. This is expected within a few days.

The contract calls for 300 tractors at $5,000 each of the heavy type recently perfected by the company after much experimenting. The cars are listed at $9,000, but the large number ordered will reduce the price to $5,000. The machines are gasoline driven, 120-horsepower, and four-wheel drive. They will be fitted with armor shields of 5/8-inch steel plate. The patented feature of the Morton tractor is the steering gear, which controls both axles, so that the rear wheels follow exactly in the tracks of the front wheels. This, with the four-wheel drive, is a strong factor of added power in traveling muddy roads and crossing rough country in military service. The tractors will be used to draw gun carriages, ammunition and provision trains. They can climb a 45-degree incline.

The Morton company has leased a portion of the Harrisburg Boiler works to facilitate the work of handling the big order.

Stewart-Warner Earns 10% on Common

CHICAGO, ILL., Feb. 23—The Stewart-Warner Corp.'s net profits available for dividends on its $10,000,000 common stock in 1914 were equal to 10 per cent. The common stock is at present listing at 48, while the preferred is listing at 101. In 1913 the company earned 10.88 per cent.

PHILADELPHIA, PA., Feb. 17—The directors of the Electric Storage Battery Co. have declared a dividend of 1 per cent. from the net earnings of the company on both common and preferred stocks, payable April 1, 1915, to stockholders of record at the close of business on March 22, 1915.

FREMONT, O., Feb. 19—The Lauth-Juergens Motor Truck Co., recently passed a resolution to issue $100,000 in 7 per cent. preferred stock.

Goodrich 1914 Net Sales $41,764,008

NEW YORK CITY, Feb. 24—The pamphlet report of the B. F. Goodrich Co., shows a net profit for the year ended December 31, 1914, of $5,440,427, an increase over the previous year of $2,840,680. the net profit being carried to the surplus account for the year. The surplus for the year compares with $2,599,747 surplus for dividends in the previous year. The year's net sales amounted to $41,764,008. A total of $2,968,500 was paid out in dividends, and 9,000 shares of the 7 per cent. preferred stock were retired at par. A balance of $3,177,909 was carried to surplus, against $705,982 at the close of the previous year. The preliminary report was published in THE AUTOMOBILE for February 4.

B. G. Work, president of the company, said in the report that the Société Francaise B. F. Goodrich, the French company, after ceasing operations for a few months, is again in operation and making a good showing.

Dorris Brings Out Seven-Passenger Six

ST. LOUIS, MO., Feb. 18—In adding a six-cylinder car to the Dorris line the Dorris Motor Car Co., St. Louis. has adhered to standard Dorris features of design, including unit power plant, multiple disk dry clutch, overhead valve mechanism with inclosed valves and speedometer drive from the inside of the gearcase. The car is built as a seven-passenger touring, has a wheelbase of 128 inches, 36 by 4 1-2-inch tires,

Automobile Securities Quotations

NEW YORK CITY, Feb. 24—Values were somewhat unsteady in the automobile securities market during the past week, but the general tendency might be described as continuing the upward trend which has marked the transactions of the past month. White stock was strong, registering a gain of 5 points. Kelly-Springfield common was 4 1-2 points higher than last week although the second preferred lost 1. Miller Rubber showed a gain of 8 points. Goodrich and Maxwell values also improved. Portage Rubber common declined 4 points and the preferred 5.

	1914 Bid	1914 Asked	1915 Bid	1915 Asked	Net Ch'ges.
Ajax-Grieb Rubber Co. com	200	..	250	..	..
Ajax-Grieb Rubber Co. pfd	98	101	100	..	..
Aluminum Castings pfd	97	100	95	100	..
Chalmers Motor Co. com	85	90	..	94	..
Chalmers Motor Co. pfd	92	94	91	94	..
Firestone Tire & Rubber Co. com	260	..	370	375	..
Firestone Tire & Rubber Co. pfd	105	107	109	111	+1
General Motors Co. com	59	61	94	95	— ½
General Motors Co. pfd	89	91	95	95½	..
B. F. Goodrich Co. com	24	25	33	33¼	+2
B. F. Goodrich Co. pfd	90	91	96¼	97½	+ ¼
Goodyear Tire & Rubber Co. com	215	225	190	194	—1
Goodyear Tire & Rubber Co. pfd	98	100	101	102	..
Gray & Davis, Inc., pfd	90	97	..	..	..
International Motor Co. com	..	5	..	..	..
International Motor Co. pfd	..	15	..	..	..
Kelly-Springfield Tire Co. com	48	50	112½	113	+4½
Kelly-Springfield Tire Co. 1st pfd	115	125	84	85	..
Kelly-Springfield Tire Co. 2d pfd	..	..	121	124	—1
Maxwell Motor Co. com	5	5½	22¾	23¼	+ ¼
Maxwell Motor Co. 1st pfd	27	27½	61½	62	+2½
Maxwell Motor Co. 2d pfd	8	8½	25	25¼	+1
Miller Rubber Co. com	..	..	158	165	+8
Miller Rubber Co. pfd	..	..	101	103	..
Packard Motor Car Co. com	..	..	..	100	..
Packard Motor Car Co. pfd	95	99	93	..	—2
Peerless Motor Car Co. com	15	25	15	21	+2
Peerless Motor Car Co. pfd	75	80	..	55	..
Portage Rubber Co. com	..	40	30	36	—4
Portage Rubber Co. pfd	..	90	80	85	—5
*Reo Motor Truck Co	7½	8½	11½	12	— ¼
*Reo Motor Car Co	17½	18½	24½	25¼	— ¼
Stewart-Warner Speed. Corp. com	55	56	51	53	— ½
Stewart-Warner Speed. Corp. pfd	97	100	100½	102	+ ½
Studebaker Cor. com	28	30	46¾	47	+1¾
Studebaker Cor. pfd	85	87	95	96½	..
Swinehart Tire & Rubber Co	69	71	69	71	—2
U. S. Rubber Co. com	59	60	56½	57½	+ ½
U. S. Rubber Co. pfd	101½	102	102	103½	..
White Co. pfd	105	110	108	110	+5
Willys-Overland Co. com	66	68	95½	97½	+ ½
Willys-Overland Co. pfd	91	95	..	..	..

*Par value $10; all others $100.

Market Reports for the Week

NEW YORK CITY, Feb. 24—The dramatic rise of tin was the only important change in this week's market reports. On Friday this metal rose to $39.75 per 100 pounds from $37.00, due to speculative operations at London, alarm concerning shipping and frightened dealers and consumers. Tin was strong, excited and unsettled with prices irregular because of the psychological conditions surrounding the market arising largely from the alarm over the prospect of small shipments from London. The result of the violent fluctuations in tin in foreign markets during the last few days has been to almost entirely check trading in this city, both dealers and consumers being at sea. Cottonseed oil dropped $0.55 per barrel. Beams and channels rose to $1.26 per 100 pounds at a 5-cent gain. Business in the local market for crude rubber was more active on Tuesday. The market retained a firm tone and higher prices were demanded in some instances for plantation grades. Reports in regard to the condition of trade in rubber goods are generally favorable.

Material	Wed.	Thurs.	Fri.	Sat.	Tues.	Week's Changes
Antimony	.18½	.18½	.18½	.18¼	.18½	.....
Beams and Channels, 100 lbs.	1.21	1.26	1.26	1.26	1.26	+.05
Bessemer Steel, ton	18.50	18.50	18.50	18.50	18.50	.....
Copper, Elec., lb	.14⅜	.14½	.14½	.14½	.14⅜	+.00¼₀
Copper, Lake, lb	.14¾	.14⅝	.14⅝	.14⅝	.14¾	.....
Cottonseed Oil, bbl	7.15	7.05	7.00	6.90	6.60	—.55
Cyanide, Potash, lb	.21	.21	.21	.21	.21	.....
Fish Oil, Menhaden, Brown.	.14	.41	.41	.41	.41	.....
Gasoline, Auto, bbl	.12	.12	.12	.12	.12	.....
Lard Oil, prime	.92	.92	.92	.92	.92	.....
Lead, 100 lbs	3.85	3.85	3.85	3.85	3.85	.....
Linseed Oil	.60	.60	.60	.60	.60	.....
Open-Hearth Steel, ton	18.50	18.50	18.50	18.50	18.50	.....
Petroleum, bbl., Kans., crude	.40	.40	.40	.40	.40	.....
Petroleum, bbl., Pa., crude.	1.50	1.50	1.50	1.50	1.50	.....
Rapeseed Oil, refined	.75	.75	.75	.75	.75	.....
Rubber, Fine Up-River, Para	.58	.58	.58	.58	.58	.....
Silk, raw, Ital	..	3.90	..	3.90	3.90	.....
Silk, raw, Japan	..	3.32½	..	3.30	3.35	.....
Sulphuric Acid, 60 Baume.	.90	.90	.90	.90	.90	.....
Tin, 100 lb	36.00	37.00	39.75	39.50	38.75	+2.75
Tire Scrap	.05	.05	.05	.05	.05	.....

complete equipment including Westinghouse starting and lighting and sells for $2,475.

The cylinders are cast in threes and are 4 by 5, with valves in the heads operated through long push-rods and overhead gear; all the overhead parts are inclosed by a top housing of extremely neat design. A single camshaft with integral cams is employed. The crankshaft not only is unusually large, being 2 1-4 inches in diameter at the bearings, but it runs in seven bearings, so that each crank is supported on each side.

Lubrication is by constant level splash, the oil being circulated by a gear pump; a sight feed is mounted on the dash and an oil gauge on the crankcase. Cooling of the radiator is furthered by the fan-type flywheel, which exhausts the hot air from under the hood and draws in cool air through the radiator. The Westinghouse electrical system takes care of ignition as well as starting and lighting. The carbureter is a Stromberg with hot-water jacketed intake pipe.

The three-speed gearset is mounted as a unit with the motor, though there is no housing around the flywheel; the gear shafts run in Timken roller bearings, adjustable for wear. The dry disk clutch is housed in the flywheel, and is sufficiently small to leave ample room for the fan spokes.

Drive from the gearset to the rear axle is through a propeller shaft with two universals completely inclosed and running in grease. The rear axle is a full-floating Timken with helical bevels and a differential that is removable through an opening at the rear of the housing; Timken roller bearings are used in both axles.

The rear spring suspension consists of a three-point platform system with 50-inch side springs and a 40-inch cross spring; front springs are semi-elliptics 42 inches long. Front springs are 2 1-4 inches wide and rear springs 2 1-2 inches. The steering gear is a Gemmer worm and gear, adjustable.

Both brakes are on the rear hubs and are 14 inches in diameter by 2 1-2-inch face; the service brake is contracting and the emergency brake expanding.

The equipment includes an engine-driven tire pump, Golde one-man top, rain vision ventilating windshield, 60-mile Stewart speedometer, tire carriers at the rear, an extra demountable rim, 10-inch electric headlights of the double bulb type, electric tail light with license carrier, electric inspection light, Klaxet horn, robe rail and foot rest, and the usual jack and tool outfit.

Herff-Brooks Small Four at $765

INDIANAPOLIS, IND., Feb. 23—The Herff-Brooks Corp., this city, has announced a new small four, called the Herff-Brooks 25, which sells for $765. The car will be made at the Richmond plant. It has a four-cylinder motor, developing 25 horsepower, the cylinders being block cast. A few other features are inclosed valves, unit power plant with three-point support and aluminum crankcase and gearbox. Cooling is by thermo-syphon, through a tubular radiator. The Atwater Kent Unisparker ignition system is used. There are three speeds forward with one reverse. Left hand drive and center control are used. The car has a 106-inch wheelbase.

Now Detroit Ward Leonard System

DETROIT, MICH., Feb. 23—The Detroit Starter Co. has recognized the validity of the late H. Ward Leonard's recently marketed patents and has entered into an arrangement by which it is now licensed to manufacture under these patents.

Hereafter the product of the Detroit Starter Co. will be known as the Detroit Ward Leonard system for starting and lighting and will continue to be manufactured in the plant of the Ross & Young Machine Co., Detroit. The officers of the Detroit Starter Co. are: J. W. Fitzgerald, president; F. J. Lamb, vice-president; A. D. Porter, secretary and treasurer, and H. M. Jerome, general manager.

Service Gear & Machine Co. Buys Parts

READING, PA., Feb. 19—The Service Gear & Machine Co. has purchased the entire stock of gears, shafts, patterns, etc., of the service department of the American Die & Tool Co. of this city. The former company will maintain a stock of transmission gears, spline shafts, countershafts, bevel differential gears and axle shafts for a great many obsolete cars. This stock will be carried in Reading and by the company's dealers throughout the country. J. D. Kaufman, formerly with the American company, will have charge with headquarters in Reading. The American Die & Tool Co. hereafter will devote its energies to the production of transmissions, small car rear axles, gears, etc., for manufacturers only.

President Smith Appointed U. S. L. Co-Receiver

BUFFALO, N. Y., Feb. 23—Judge Hazel here Monday in federal court, appointed J. Allan Smith, president of United States Light & Heating Co., Niagara Falls and Buffalo, as co-receiver for that concern, the affairs of which for the past several months have been in the hands of receivers, James O. Moore and James A. Roberts. Mr. Smith is required to file bond for $50,000.

Mr. Smith's appointment as receiver followed motion made 3 weeks ago by counsel for the heating company. At the time there was considerable debate as to whether Mr. Smith would be suitable to act as receiver because of his connection with the Niagara Falls company as president. The Central Trust Co. of New York City, which started an action in equity against the Niagara Falls concern, as well as other creditors, were strongly opposed to the appointment of Mr. Smith and through their lawyers they entered numerous objections. The two original receivers were present and they heartily urged that Mr. Smith be named as third receiver.

In his opinion filed Monday, Judge Hazel holds that although the Central Trust Co. of New York and other large creditors object to the appointment, he believed it would promote the best interests of the defendant company. When the original receivers for the concern were appointed President Smith was in Europe on business. Mr. Smith, in accepting the appointment, waives the usual fees and commissions. Judge Hazel, however, decrees that an order may be entered providing that Mr. Smith's annual salary shall cover additional services he performs as receiver.

Five More Tire Makers Lower Prices

NEW YORK CITY, Feb. 23—Practically all makers of tires have now readjusted their prices in accordance with the downward movement instituted about a month ago. Comparisons of the new and old list prices have been given in THE AUTOMOBILE as they have been made and this week there are presented in the accompanying table the new and old lists of four principal sizes of those tires whose new figures had not previously been listed, Batavia, Federal, Michelin, Miller and Republic. In some cases February 1 is the date when readjustment went into effect.

New and Former Prices of Five Tire Makers for Four Principal Sizes

	30 × 3		32 × 3½		34 × 4		36 × 4½	
	Old	New	Old	New	Old	New	Old	New
Batavia								
Plain tread	$14.20	$12.15*	$20.00	$18.00	$29.65	$26.70	$39.50	$34.55
Security tread	17.10	12.35†	24.00	21.00	35.15	30.75	45.75	3.00
Red tube	3.50	3.00	4.50	3.85	6.25	5.30	8.25	7.00
Federal								
Plain tread	11.70	9.35	16.75	13.95	24.35	20.35	35.00	28.70
Rugged tread	13.80	10.75	19.70	16.05	28.50	23.40	40.98	33.80
Gray tube	2.80	2.35	3.70	2.80	4.90	4.00	6.45	5.30
Redskin tube	3.10	2.60	4.30	3.10	5.45	4.45	7.20	5.90
Michelin								
Soft bead	13.00	11.50	19.75	16.50	28.00	24.50	35.50	31.75
Q. D. clincher	....	....	20.75	18.00	28.00	24.50	35.50	31.75
Q. D. straight side	....	....	20.75	18.00	28.00	24.50	35.50	31.75
Steel studded	22.00	22.00	30.00	30.00	38.50	38.50	46.00	46.00
Tube	3.50	2.90	4.50	3.50	6.25	4.95	8.25	6.60
Miller								
Smooth tread	12.25	10.95	18.60	16.50	27.05	23.95	38.90	32.15
Non-skid	14.10	12.60	21.40	19.00	31.10	27.55	44.75	36.95
Gray tube	2.80	2.35	3.70	2.80	4.90	4.00	6.45	5.20
Republic								
Plain tread	13.25	11.35	18.35	15.70	28.25	23.80	40.00	34.20
Staggard tread	19.10	16.35	26.75	22.85	36.40	31.15	48.95	41.85
W M tread	13.95	11.95	19.35	16.55	29.75	25.45	42.10	36.00
Gray tube	2.90	2.30	3.90	3.05	5.35	4.20	7.00	5.50
Red tube	4.20	3.30	5.30	4.20	6.40	5.05	9.55	7.50

*Molded. Wrapped, $12.80. †Molded. Wrapped, $14.95.

To Hold Vanderbilt March 6

Bad Weather Stops Practice—Protest Against Holding Vanderbilt Cup Race After Grand Prix

SAN FRANCISCO, CAL., Feb. 22—*Special Telegram*—The Vanderbilt Cup Race was called off at noon today on account of inclement weather. March 6 is set for the start. The first practice, which was held from daylight to 9 o'clock Sunday morning, was featured by two wrecks. Eddie O'Donnell, driving the Duesenberg No. 19, was one of the first on the course. Driving through a gate at the far end of the Great Park, he saw that the guards had been stationed and started around. The car made fast time on the asphalt and went on to the boarded part of the track, which covered the dirt section of the course, at about 40 miles an hour.

During the night a heavy frost had whitewashed the planked track and the boards were as slippery as ice. O'Donnell battled with the wheel until he reached the center of the turn, then skidded through the outside fence. His car landed 15 feet off the course, turned end for end in a ditch. No serious injuries occurred. The second accident occurred when T. Tomasini skidded in front of the grandstand. The mud and slush under the boards came up through the wide cracks in the planking as the cars went over the timber and soon the boarded course was a muddy skid bed.

The decision on the part of the race officials to run the Vanderbilt after the Grand Prix, which is scheduled for February 27, started a wrangle. The Venice Grand Prix, scheduled for March 17, is being run under the auspices of the W. A. A. Officials of the Western Automobile Association who are here at the exposition protested that to postpone the Vanderbilt until March 6 would interfere with their event, which had already been sanctioned.

Cornelian Is Indianapolis Smallest Entry

INDIANAPOLIS, IND., Feb. 24—The speedway officials announce the entry in the 500-mile race May 30, of the Cornelian, to be driven by Louis Chevrolet. This little car will be the smallest that ever competed in the speedway classic. The whole car weighs but 1,000 pounds and has a displacement of only 95 cubic inches, less than one-third of the limit. The motor weighs less than 190 pounds and rates according to the S. A. E. formula at 12.1 horsepower at 1,000 feet per minute piston speed.

This car is made by the Blood Bros. Machine Co., Allegan, Mich. and made its début as a racer in the 100-mile race at Kalamazoo last fall, finishing seventh in a field of thirteen. The Indianapolis entry is almost a duplicate of the Kalamazoo entry.

The motor is a four-cylinder Sterling valve-in-head type, 2 7-8 by 4 inches in size. Valves are 1 1-4 inches in diameter and the pistons are of a special aluminum alloy. The motor is capable of a speed of 3,500 r.p.m. and the gear ratio is 3 to 1. Tires are 30 by 3 1-2 inches instead of the 28 by 3 inch tires used as stock.

There are three unique features of Cornelian construction which also have been incorporated in the racer. One of these is the rear axle. This is a flexible axle, much like that of the De Dion. This involves the use of four universals in the axle. The differential and bevel gears are mounted on the chassis and are carried on the springs so that unsprung weight is a minimum. Each wheel is independent of the other and does not carry the dead axle weight.

The front axle is provided with two transverse half-elliptic springs. The rear suspension comprises a three-spring transverse half-elliptic platform. A single sheet-steel shell comprises both body and frame. The racing body is narrow and has a long streamline tail.

Maxwell Builds Seven Racing Cars

DETROIT, MICH., Feb. 19—With Ray Harroun as the moving spirit in the enterprise, the Maxwell company will manufacture seven racing cars for the coming season. Harroun will superintend the construction of the cars, and will be permanently connected with the Maxwell company, in the capacity of chief engineer.

These racing cars, at present under construction at the factory of the Maxwell Motor Co., will be entered in most of the speedway events of the 1915 season. The different cars will be constructed for different classes so that their itinerary will include almost every race scheduled between the coasts. One or two drivers have already been selected to pilot the new racers.

Meetings, Elections and Conventions

NEW YORK CITY, Feb. 19—The directors of the Automobile Dealers' Assn. of this city held a meeting today in the association rooms for the purpose of electing officers. R. H. Johnston of the White Co., who has been president of the association for the past year was unanimously elected of the office of president for 1915. C. H. Larson of the Oldsmobile company was unanimously re-elected to the office of vice-president. Charles M. Brown of the Winton Motor Car Co. was unanimously elected secretary and treasurer of the organization in place of Frank Eveland of A. G. Spalding & Bros., who resigned on account of his company going out of the automobile business.

This is the first meeting of the new board of directors which was elected at the annual meeting of the association held February 4. The names of the directors are as follows: M. J. Budlong, Packard Motor Car Co.; C. M. Brown, Winton Motor Car Co.; Geo. Stowe, Chalmers Motor Car Co.; C. H. Larson, Oldsmobile Company; H. L. Stratton, Colt-Stratton Co.; Wm. C. Poertner, Poertner Motor Car Co.; R. H. Johnston, White Motor Car Co.; J. F. Plummer, Locomobile Co. of America; Sidney B. Bowman, Bowman Auto Co.; and Wm. Parkinson, Stutz Motor Car Co.

JEANNETTE, PA., Feb. 19—At the annual meeting of the directors and stockholders of the Pennsylvania Rubber Co., the following officers were elected: Herbert DuPuy, chairman of the board; H. W. DuPuy, president-treasurer; C. M. DuPuy, vice-president; S. G. Lewis, general manager; G. W. Shiveley, secretary, and C. G. Morrill, assistant treasurer.

FLINT, MICH., Feb. 19—Presided over by general sales manager J. D. Mansfield, of the Dort Motor Car Co., about twenty-five district sales managers and big dealers of that new company held their first convention this week. Among the various subjects which were discussed was the condition of the automobile business in the United States, the outlook in the various states, dealers' selling campaigns and the establishment of service stations.

DETROIT, MICH., Feb. 18—A convention of all the salesmen, traveling men, department managers of the automobile department of the H. W. Johns-Manville Co., located in the lower peninsula of the state of Michigan was held at the headquarters of the company in Detroit. The general conditions of the trade and more especially those lines handled by the company were discussed. The meetings, at which about forty-five men of the sales organization took part, were presided over by Edward A. Cassidy, general manager.

Truck Club Discusses Recording Instruments

NEW YORK CITY, Feb. 17—"Effects of Self-recording Instruments in Increasing Deliveries and Decreasing Repairs" was the subject discussed at the regular monthly meeting of the New York section of the Motor Truck Club of America, held tonight in the auditorium of the Automobile Club of America. Three papers were submitted. One written by H. A. Long, general manager of the Service Recorder Co., Cleveland, O., was read by V. E. B. Fuller, local manager of the same company, in the absence of its author. Another, written by Gridley Adams, advertising manager of the Stewart Warner Speedometer Corp., Chicago, was read by the club secretary, F. Nelson Carle. The third was prepared and read by E. McGuirk, sales manager of the American Taximeter Co., New York City. Arthur Mayer of the Speedograph Corp., New York City, cited several instances where companies using the instruments manufactured by the Speedograph company on their trucks had been enabled to denote serious irregularities of operation and save considerable money as a result.

None of the papers presented described the instruments made

by the respective companies, but discussed their application and cited cases where their use had enabled owners to know just what their trucks were doing when out on long trips; to detect overspeeding; excessive loading and unloading times, loafing on the routes and more than 1-hour lunch periods.

Mr. Long defined truck recording devices as some form of instrument which records time, mileage, speed, temperature, gasoline or oil consumption, or some combination of these, and which provides a permanent record in the form of a tape or chart. There are two types of such instruments, one, which is operated from the wheel through a flexible shaft, and the other, self-contained and having no connection with any moving part of the vehicle.

Mr. McGuirk touched briefly on the development of the taxicab and its recording device, and stated that the taxicab business had been made possible only by the use of a reliable recording device. The fares are calculated from the cost of operation per mile, as shown by the recording instrument. In a similar manner no truck operator can say positively just what his cost of operation is unless his vehicles are equipped with some sort of device which registers accurately the mileage covered each day. This point was forcibly brought out in the paper of Mr. Adams, who cited an example showing the great variance of cost-per-ton-mile figures when the mileage was guessed at instead of being determined from some type of reliable recording instrument.

Little discussion followed the reading of the three papers. G. H. Pride, of the Heavy Haulage Co., of this city, however, stated that he did not believe in instruments of this nature, because in his belief, there are none made which cannot be tampered with and put out of commission or circumvented in some manner. He believes in a truck owner knowing his business so thoroughly that no mechanical devices are necessary to determine irregularities of operation.

The next meeting will be held on Wednesday evening, March 17, at the Automobile Club of America. J. E. Cassidy, of the Postal Transfer Service Co., Inc., New York City, will present a paper on Traffic Problems as Found in the Operation of Motor Vehicles.

Horizontal Shocks with Cantilever Springs—Flame-Welded Clips

(*Continued from page* 361)

which the vertical component is the principal one, if it is made suitable for the worst horizontal components that may occur. But I suppose you let this pass, in default of something better, because it is common practice to have the front springing harder than it ought to be and helping it out, if pneumatic tires are used, by having these softer than they ought to be. You admit, of course, that the proposed makeshift still leaves the problem of doing better for commercial vehicles with solid front tires, and meanwhile it argues pretty strongly for using solid rear and pneumatic front tires as done by express companies and many private users of 1 to 2 ton wagons.

Trusting that our discussion will stimulate others to turn a few persistent thoughts in the same direction, I remain, as ever, truly yours,

New York, February 20, 1915. ALTER EGO.

Mr. Ego's letter certainly clears the ideas with regard to the need of separating the vertical and horizontal functions of a compound spring. Only with regard to the suggested front spring construction, Fig. 21, an exception may be taken. It is a combination spring in another sense from that previously used. The spring here yields obliquely in the average direction of a compound shock, and it will, as contended and admitted, be a little hard for purely vertical shocks. It will also be too soft for the severest horizontal shocks, if the rear load of the vehicle is much greater than the front load. It is a compromise—with a parallel in the front wheels of bicycles and in some early automobiles. But there is a strong probability that horizontal shocks of front axles are considerably milder than they can be figured, on account of the degree of flexibility always existing in vehicle frames and in wheels which perhaps delays the transmission of the momentum from the rear mass of the vehicle, in some measure, till after the road obstacle has been passed. The free rotation of front wheels, without retardation due to the inertia of the power transmission mechanism, should also have this effect. It is therefore believed that a construction of the general character shown in Fig. 21 would help materially to cushion the shocks now usually brutally resisted in the spring clips and the front pivot pins and from the latter transmitted to motor and load, and that it would do this also in the case of commercial vehicles with hard tires.

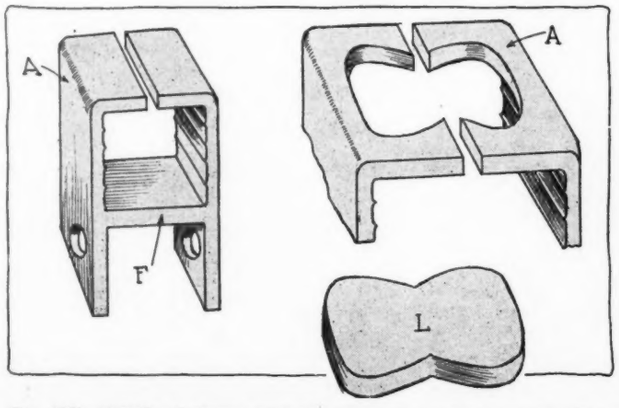

Fig. 18B—Details of flame-welded box-clip as used for construction, shown in Fig. 18A

Flame-Welded Clips

On the clip construction shown in the corrected Fig. 18, A and B, the following notes will make the suggested method perfectly clear. Stamping is the preferred process except for very heavy vehicles and springs, as it is probably the cheapest and for light and medium size vehicles will produce clips no thicker than necessary and of a suitable material. (Until the advent of chromium, clips made of Norway iron were the best.) Bushings are omitted in the sketch, also oilcups. To introduce a slightly yielding binder element within the grasp of the clip, to help in preventing longitudinal dislocation of the spring leaves while admitting the infinitesimal movements incidental to spring action in this place, the central portions of the spring leaves should be coated with a thin-flowing spelter when they are hot, before quenching and tempering. The coated areas should be mildly sandblasted to produce a suitable degree of roughness. The interior walls of the casting, forging or stamping should be corrugated in the manner shown to conform somewhat with the slightly rounded edges of the spring leaves. The top of the clip should be split, the split to overlap with chamfered edges if necessary.

To assemble, the clip is pried open sufficiently for the insertion of the leaves. One or two thin brass shims are wedged in at the top. The clip is then clamped firmly around the spring, and the split is closed by autogenous welding, the clamp staying on till the joint is cold. No pin is used. If it is found necessary at any subsequent occasion to take the spring apart, the joint is sawed open.

Additional security against slipshod workmanship in the welding, and in the case of heavy vehicles, may be obtained by forming the top of the clip with suitable cut-outs at both sides of the split and welding a locking piece L into the space thus formed, the clamp being used as before and weld metal as needed. Similar methods could be devised for clipping a spring to an axle with some gain in strength, neatness and cost over present methods, but other forms of construction may be better worth trying where it is desired to allow the spring a slight rocking motion on the axle, so as to obviate torsion of the leaves, as now done in many French cars and in some trucks.

Factory Miscellany

THIRTY Nationalities Represented—Between December 15 and February 10 18,200 men have applied to the Board of Commerce, Detroit, Mich., seeking employment. They have been classified, and according to the records they represent thirty different nationalities. Of the total 7,155 were skilled or semi-skilled workers and 11,045 could not be listed under any special trade, mostly being laborers. Among the 7,155 listed unemployed a large percentage came under the automobile and its allied trades classifications—21 per cent. being semi-mechanics, 4 per cent. full mechanics, 7 per cent. automobile body trade workers, 9 per cent. machine operators, 5 per cent. foundry workers, 3 per cent. sheet metal workers, 13 per cent. workers of building trades, 6 per cent. office workers, 5 per cent. domestics, 3 per cent. drivers, 20 per cent. laborers speaking English and 4 per cent. miscellaneous.

Paige on 24-Hour Schedule—The Paige-Detroit Motor Car Co., Detroit, Mich., is now working on a 24-hour schedule, with three 8-hour shifts.

Swinehart Planning Addition—The Swinehart Rubber & Tire Co., Akron, O., is having plans made for a 3-story reinforced concrete and brick addition, 60 by 130 feet, to be built at a cost of $75,000.

Pennsylvania Increases Force.—The Pennsylvania Rubber Co., Conshohocton, Pa., will increase its force from 800 to 1,400 as soon as the company's new plant is opened. This is expected to take place in 2 weeks.

F. & H. Wire Wheel in Springfield—The F. & H. Wire Wheel Co. is moving its plant and offices from Columbus, O., to Springfield, O., on account of increased manufacturing facilities and other inducements. It will have at its disposal a much larger plant with greater facilities for machine work and assembling.

Ford Building in Buffalo—The Ford Motor Co., Detroit, Mich., has had plans prepared for an assembling plant in Buffalo, N. Y., which will be 200 by 450 feet in size, four stories and basement, of reinforced concrete, and will be erected on a site at Main street and the New York Central Railroad Belt Line, at an estimated cost of about $400,000.

Kramer Leases Bailey Plant—The Kramer Auto & Carriage Co., Lancaster, Pa., has been incorporated with a capital stock of $5,000 by I. N. and G. R. Kramer, of Goodville, Pa., and Edward McLaughlin, of Lancaster, to manufacture vehicles and commercial automobile bodies. It has leased the former factory of S. E. Bailey & Co., on North Queen street, Lancaster. Edward McLaughlin is president, and I. N. Kramer, purchasing agent.

Wagner Resilient Purchases Plant—The Wagner Resilient Wheel & Tire Co., Chelsea, Mich., which was organized in Chicago last year under the laws of the State of Michigan, with a capital stock of $500,000, has purchased the plant formerly occupied by the National Peat Fuel Co., and will start manufacturing within a short time. The officers of the company are: W. F. Wagner, president; T. E. Russell, vice-president; A. C. Baird, secretary-treasurer. These officers and Wm. T. Ferguson and G. H. Karicofe makeup the board of directors.

To Mfr. Safety Fenders in Columbus—The Interstate Automatic Safety Fender Co., Columbus, O., has been organized with a capital of $10,000 for the purpose of manufacturing and selling fenders for motor trucks, under the patents held by the Automatic Safety Fender Co., of Chicago. It is planned to open a factory in Columbus and to cover the states of Ohio, West Virginia and Kentucky. Offices have been opened in room 74, Ruggery Bldg. J. V. Morgan is president; J. B. Moore, vice-president; E. J. Kinnison, secretary, and Peter Napier, treasurer.

Producing Light Car Motors—The plant of the Milwaukee Machine Tool Co., Sixtieth avenue and Mitchell street, West Allis, Wis., which passed into the possession of the Kearney & Trecker Co., milling machines, several years ago, is now devoting practically its entire attention to the production of gasoline motors for small cars. More than 2½ years of experimentation was undergone before the motors were placed on the market. The trade name of "Le Roi" has been adopted for the engine, which is built in two sizes, 2⅞ by 4 inches and 3⅛ by 4½ inches bore and stroke.

Rayfield Arranges for Large Production—The Rayfield Motor Co., Chrisman, Ill., has completed arrangements to produce the Rayfield "20" in large quantities. The engines, transmissions and axles will be supplied by the Pittsburg Model Engine Co.; the bodies and tops will be built in Indianapolis; the hoods, fenders and radiators will be made in Detroit; wheels will be built in Columbus, O.; springs, in Chicago, and the frames in Milwaukee; the final assembly will be made at the Rayfield Motor Co.'s plant at Chrisman, and the Great Western Automobile plant at Peru, Ind. With the two plants in full operation, it will give the company a capacity of at least fifty cars per day. The company has seventy-five agencies.

The Automobile Calendar

Feb. 22-25	Allentown, Pa., Show.
Feb. 22-27	Duluth, Minn., Show, Auditorium.
Feb. 22-27	New Haven, Conn., Show, Second Regiment Armory; W. N. Lindsay.
Feb. 22-28	South Bethlehem, Pa., Show, Coliseum; J. L. Elliott.
Feb. 23-27	York, Pa., Show, Coliseum Hall.
Feb. 23-27	Syracuse, N. Y., Show, Armory, Syracuse Auto Dealers' Assn.; H. T. Gardner, Mgr.
Feb. 23-27	Ft. Dodge, Ia., Show, Armory, C. W. Tremain, Sec.
Feb. 24-27	Freeport, Ill., Show, Freeport Automobile Show Co.
Feb. 27	San Francisco, Cal., Panama-Pacific Exposition, Grand Prize Race, Panama - Pacific Exposition Grounds; Promoter, Panama-Pacific Exposition Co.
Mar. 1-5	Wilkesbarre, Pa., Show. Vehicle Trades Assn.
Mar. 1-6	Fargo, N. D., Show, Armory.
Mar	Benton Harbor, Mich., Show, St. Joseph and Benton Harbor, St. Joseph Garage, St. Joseph.
Mar	Charlotte, Mich., Show.
Mar. 2-9	Brooklyn, N. Y., Show, Motor Dealers' Assn., 23rd Regiment Armory.
Mar 3	Albany, N. Y., Associated Garages of America, General Convention.
Mar. 3-4-5-6	St. Joseph, Mich., Show, St. Joseph Auto Co. Bldg.
Mar. 4-6	Springfield, Mass., Show; J. H. Graham.
Mar. 6	San Francisco, Cal., Vanderbilt Race, Panama-Pacific Exposition Grounds.
Mar. 6-13	Boston, Mass., Show, Mechanics Bldg., Boston Auto Dealers Assn., Boston Commercial Motor Veh. Assn.
Mar. 6-13	New York City, Made in the U. S. A. Exhibition, Grand Central Palace.
Mar. 8-13	Indianapolis, Ind., Annual Spring Opening, Indianapolis Auto Trade Assn.
Mar. 8-13	Des Moines, Ia., Show, C. G. Van Vliet.
Mar. 8-13	Utica, N. Y., Utica Automobile Trade Assn.
Mar. 13-20	Harrisburg, Pa., Show Arena, Harrisburg Dealers' Assn.
Mar. 14	San Francisco, Cal., Panama - Pacific Cup Race, Panama - Pacific Exposition Grounds; Promoter, Panama - Pacific Exposition Co.
Mar. 17	Venice, Cal., Cal. Grand Prix, 300-Mile Road Race.
Mar. 17-20	Elgin, Ill., Show, W. H. Tidmarsh, Mgr.
Mar. 22-27	Bangor, Me., Show, Bangor Auditorium.
April	Calumet, Mich., Show, Coliseum.
April 3	Paterson, N. J., Show, Auditorium, R. A. Mitchell.
Apr. 16	Manchester, Eng., Show, Ice Palace, North of England Motor Shows, Ltd.
May 17-18	Boston, Mass., A. A. A. Annual Meeting.
May 29	Indianapolis, Ind., 500-Mile Race, Indianapolis Motor Speedway.
June 9	Galesburg, Ill., Two-mile Track Meet.
June 19	Chicago, Ill., 500 - Mile Race, Chicago Speedway.
June 25	Sioux City, Ia., Track Meet.
July 4-5	Tacoma, Wash., Road Race.
Aug	Milwaukee, Wis., Independent Petroleum Marketers' Assn. of the U. S.; 1915 Convention in Milwaukee.
Aug. 2-3	San Francisco, Cal., Tri-State Good Roads Assn., Third Annual Convention.
Aug. 20-21	Elgin, Ill., Road Race.
Sept. 20-25	San Francisco, Cal., International Engineering Congress.

The Week in the Industry

Motor Men in New Roles

MEERS Empire Commercial Mgr—I. B. Meers has been appointed mercial manager of the Empire Automobile Co., Indianapolis, Ind. Entering upon his new duties Mr. Meers is now on an extended trip through the West in the interests of the Empire company, with which he was formerly connected as export sales manager.

Bishop Joins King—R. P. Bishop has been appointed assistant sales manager of the King Motor Car Co., Detroit, Mich. He was formerly sales manager of the Cutting Motor Car Co.

Mevis Heads Springfield Buick—G. A. Mevis has been appointed manager of the Springfield Buick Co., Springfield, Mass. The company will move to 650 Main street on or about March 1.

Hanks Heads Indianapolis Westinghouse—The Westinghouse Electric & Mfg. Co. has opened a sales and service station in charge of M. W. Hanks at 427 North Meridian street, Indianapolis, Ind.

Green Resigns from Speedwell—C. R. Green has resigned as chief engineer of the Speedwell Motor Car Co., Dayton, O., and has accepted a position in a similar capacity with the Mead Engine Co., Dayton, O.

McCleary Heads Dodges' Metallurgy Dept.—Dodge Bros., Detroit, Mich., recently completed extensive additions and changes in the metallurgical department of the plant. F. E. McCleary is in charge of the department.

Hockaday Mgr.—Ray Hockaday, of Wichita, Kan., will be the manager of the Hutchinson (Kan.) branch of the Hockaday Automobile Supply Co., to be opened March 1. The firm will take the building at 27 Sherman east.

Simpson Apperson Mgr.—B. A. Simpson, during the last 6 years with the Omaha (Neb.) Buick agency, has been appointed manager of the retail business of the local Apperson Jack Rabbit Automobile Co., 2417 Farnam street.

McGiehan Resigns from Motz—T. H. McGiehan, vice-president and general manager of the Motz Tire & Rubber Co., Akron, O., has resigned his position, effective March 1, to go in the rubber supply business in New Orleans. He will represent several tire and sundries manufacturers.

Keir Troy Wagon Representative—J. L. Keir has been appointed manufacturers' agent for the Troy Wagon Works Co., Troy, O. His offices are in the Abbott Bldg., Broad and Race streets, Philadelphia, Pa. He will handle Troy motor truck trailers, reversible traction-drawn wagons and dump wagons.

Quinn Pittsburgh Goodyear Mgr.—J. M. Quinn is the new manager of the Pittsburgh (Pa.) branch of the Goodyear Tire & Rubber Co., 5952 Baum Boulevard. He succeeds W. A. Hazlett, who was recently promoted to the position of manager of the Goodyear branch in Detroit.

Campbell Club Treasurer—H. F. Campbell, treasurer of the Stutz Motor Car Co., Indianapolis, has been elected treasurer of the Columbia Club, Indianapolis. The Columbia is one of the oldest clubs of Indianapolis, and its membership includes a large proportion of the successful business and professional men.

Former Packard Men Make Change—G. S. Loomis and W. F. Winklemann, formerly connected with the Packard Motor Car Co., Detroit, have been appointed general manager and sales manager, respectively, of the Southern Motors Co., agent for Packard, Hudson, Dodge and Detroit electrics, Louisville, Ky.

Morris Joins Moon—J. C. Morris, formerly manager of the Johns-Manville Co., Seattle, Wash., for the entire Northwest, this week signed a contract with the Moon Motor Car Company, of St. Louis, to handle the company's automobiles in the Northwest. He assumes entire charge of that district, selecting agents in Washington, Oregon, Idaho, Montana and Colorado.

Kempff Heads Harrisburg Fisk—The Fisk Rubber Co., of New York, has leased the storeroom at 19 South Third street, Harrisburg, Pa., and will open a local factory branch and service station March 1. E. P. Kempff, formerly with the Front-Market Motor Supply Co., will be in charge. C. D. Whitney, district representative for Fisk tires in this territory, will be associated with the branch and make the Harrisburg store his headquarters.

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Garage and Dealers' Field

New Location for Knight Tires—The New England branch of the Knight Tire & Rubber Co. has been moved from 153 to 179 Massachusetts avenue, Boston, Mass.

Cleveland Oakland's New Salesroom—The Adams-Oakland Co., distributer for Oakland cars, Cleveland, O., has leased the property at 3122 Euclid avenue and will have erected a two-story salesroom and garage, to be ready in May.

Singer's N. Y. Showroom Opened—The Singer Motor Co., Long Island City, N. Y., has taken a showroom at the northeast corner of Sixty-first street and Broadway. The store was opened February 22.

Titan Battery Changes Name—Due to the existence of a battery jar marketed under the name Titan, the Titan Storage Battery Co., Newark, N. J., has changed its name to the General Lead Batteries Co. No change whatever in ownership, officers or policy is involved.

Thirty-two Fords Destroyed—A fire entailing a loss of $40,000 destroyed the three-story building at 145 South Cameron street, Harrisburg, Pa., occupied by the Ford Garage and salesrooms. Thirty-two automobiles were destroyed in the fire. The building is a total loss.

Burd Piston Ring Agents—Christman & Poole, 420-422 Jefferson street, Milwaukee, Wis., specialty distributors, have been appointed district sales agents for the Burd high-compression piston rings, covering the states of Wisconsin, Iowa, Michigan, Illinois and Minnesota.

New Smalley Daniels Plan—Smalley Daniels, manufacturers' distributor, Detroit, has completed arrangements whereby garagemen and repairmen can obtain the products of the New Era Spring & Specialty Co. at trade price without the necessity of purchasing them through the dealer of the car for which they are intended.

Westinghouse Opens Cleveland Store.—The Westinghouse Electric & Mfg. Co. has opened a department for automobile equipment at 2025 Euclid avenue, Cleveland, O., with a thoroughly equipped sales and service station. S. L. Blackburn is district manager in the southeastern territory for the company.

Deals in Waste—The Wisconsin Waste Co. has been organized at Milwaukee, Wis., to make a specialty of dealing in waste for garages, machine shops and factories. The office is at 228 Muskego avenue, and warehouse at 256 Reed street. The owners of the concern are H. E. Jacobs and L. D. Fisher. Waste will be sold at wholesale and retail.

Philadelphia Willard Service Station—The J. G. Duncan, Jr., Co., Philadelphia, Pa., official Willard L B A distributors, has opened a service station at 1311 Race street in addition to the one already maintained at 131-133 South Twenty-fourth street. The company makes a specialty of renting service batteries while car owners' batteries are being recharged or repaired.

Los Angeles Cos. Consolidate—Consolidation of the Western Motor Car Co. and the California Motor Co. was effected recently under the firm name of Earle C. Anthony, Inc., of Los Angeles, Cal. Both companies were owned by Earle C. Anthony and both are now housed in the five-story structure at Tenth and Hope streets. The new concern controls the distribution of the Packard, Chalmers and Grant lines in Southern California.

Tire Agencies Recently Established—During the past week reports from different localities have shown much activity in the way of the establishment of new tire agencies. From Seattle, Wash., comes the report that John Baisden, for some time past connected with the United States Rubber Co. in that city, has been given the local agency for the Goodyear line. A. M. Peterson has taken the agency for the Batavia tire in Washington, Oregon, Idaho, Montana and British Columbia. He has established the Pacific Tire & Rubber Co., 604 East Pike street, Seattle, Wash. A Diamond and Goodrich branch has been established in Tacoma, Wash., with the Automobile Supply Co. Ralph De Witt, 414 Columbus Savings and Trust Bldg., Columbus, O., has taken the Midgley distribution. The Polack Tire & Rubber Co., New York City, has established a branch office in the Union Central Bldg., Cincinnati, O.

Recent Incorporations in the Automobile Field

Canada

OTTAWA—Canadian Lippafd-Stewart Motor Car Co., Ltd.; $50,000; to manufacture motor trucks. T. A. Burgess, J. S. Innis, Louis Cote.

Illinois

BLOOMINGTON—Ford Garage Co.; $5,000. F. D. Hackett, J. C. Harvey, E. E. Donnelly.

CHICOUTIMI, QUE.—Chicoutimi Auto Bus Co.; $20,000. Adelard Tremblay,, Pitre Gaudreau, Louis Gagnon.

CASEY—Westcott Auto Sales Co.; $10,000; dealer. W. C. Turner, H. M. Grant, J. W. Yananay.

CHICAGO—Berlin Motor Co.; $2,500; manufacturing and dealer in machinery, tools, automobile parts. T. W. Prindeville, J. D. Daly, A. J. Schmidt.

CHICAGO—King Motor Co.; $50,000; dealer. A. P. Mackie, C. F. Woods, J. W. MacCuleban.

CHICAGO—Shoger Mfg Co.; $2,500; manufacturer in accessories. G. D. Wellington, H. C. Peterson, E. W. Clark.

ROCKFORD—Cadillac Automobile Co.; $5,000; dealers. F. P. Keyt, C. H. Erb, O. P. Kent.

Indiana

FORT WAYNE—Brosius Automobile Co; $3,600; dealer. Jesse Brosius, Andrew Brosius, H. Brosius.

INDIANAPOLIS—Adjustable Auto Shoe Co.; $10,000; dealers. W. A. Parr, L. O. Gillaspy, G. E. Parr.

INDIANAPOLIS—Scarborough Motor Guide Co.; $30,000; sale of automobile guides. Marcel Rocamora, I. R. Holycross, Claude Palmer.

LOGANSPORT—Automobile Accessories Co.; $25,000; manufacturer. C. E. Young, C. B. Billman, J. Lairy.

Kentucky

PADUCAH—Home Garage; $2,000. F. W. Katterjohn, Herbert Melton, W. F. Paxton.

Maine

PORTLAND—Gillette Safety Tire Co.; $1,000,000; rubber goods, machinery and vehicles. A. F. Jones, T. L. Croteau.

Massachusetts

BOSTON—Co-Operative Motors Corp.; $500,000; garages. B. C. Boyd, H. I. Bailey, F. B. Taylor

Michigan

DETROIT—American Double Service Tire Co.; $3,000. Hanley Dawson, J. G. and B. C. Pennell.

DETROIT—Auto Spray Co.; $10,000. R. H. Evans, H. J. Skivington, D. H. Bentley.

DETROIT—Cadillac Car Co; $12,000; dealer. Duncan Walker, H. B. Graves, Frank and I. M. Krupferx.

DETROIT—Elmer W. Brown & Co.; $5,000; accessory dealer. E. W. Brown, Christian Rasmussen, O. H. Dawson.

DETROIT—Magee Sheet Metal Machinery Co.; $10,000; to manufacture sheet metal wiring machines specially used in wiring fenders. W. R. and B. R. Magee, F. W. Atkinson.

DETROIT—Somera Carbureter Co.; $10,000; manufacturer. D. G. Meara, J. H. Means, J. F. Somerville

Missouri

KANSAS CITY—Rotary Valve Mfg. Co.; $250,000; manufacturers. C. R. Jones, J. M. Burgner, L. A. Sherman.

LA GRANGE—West Suburban Garage Co.; dealer. H. D. Howe, C. C. Collister, H. L. McConnell.

ST. LOUIS—Burger Motor Co. of St. Louis; $5,000; dealer. Mary and Ferdinand Burger, J. H. Plameier.

ST. LOUIS—Cole-Arbogast Automobile Co.; $10,000; dealer. W. B. Hunt, Wm. Schmidt, Ed. Ward.

ST. LOUIS—Gillham Motor Car Co.; $10,000; dealer. F. R. Tate, F. C. Gillham, H. W. Blodgett, Jr.

New Jersey

EAST ORANGE—Maccar Co. of New Jersey; $50,000; general automobile business. G. F. Kaliberg, W. F. Hobbie, Jr.; W. A. Boone, East Orange.

NEWARK—Wills Garage, Inc; $10,000. J. H. Wills, J. J. Wills, G. F. Braudenbugh.

New York City

NEW YORK—Aero-Cushion Tire Co.; $750,000; manufacturer. J. A. Le Daux, F. Rause, G. A. Le Daux, W. S. Locke, W. L. Biddle, M. D. Callius, E. M. Oriva.

NEW YORK—Anti-Puncture Corp.; $20,000; liquid compositions. C. M. Stanton, 105 Berkeley Place, Brooklyn; Myra Emmons, Sidney Morris.

NEW YORK—Brickner's Auto Supply Co.; $5,000; dealer. Norman Brickner, Mae Brickner, Herman Widowsky, 1741 East 12th street.

NEW YORK—W. H. Cahn Co.; $10,000; to act as agent for manufacturers of Smith motor wheel, etc. W. H. Cahn, 226 W. 70th street, New York City; J. H. Hobbs, T. J. Canty.

NEW YORK—Greene Motor Trucking Co; $6,000; motor trucking. J. M. Greene, A. A. Schwartz, D. Kaxtman.

NEW YORK—Haines Auto Accessories; $5,000; dealer. N. E. Ray, 600 West 183d street, New York City; S. E. Ginberg, H. S. Hochheimer.

NEW YORK—Hilltop Automobile Station; $10,000; general garage business. Lauritz Johansen, Margarete Johansen, R. B. Hand.

NEW YORK—Jefferyson Auto Van Co.; $1,000; trucking. Isidor Smith, S. Peskin, H. Poret, 43 E. 112th street.

NEW YORK—The John Mano Co.; $1,000; dealer. John Mano, G. H. Miller, Louis Cesky, all of 255 West 57th street.

NEW YORK—Lansden Co.; $1,000; manufacturing electric and gasoline automobiles and appliances. Martin Lipman, Emma Ullman, E. Manuel, L. Meyer; attorneys, McLaughlin & Stern, 15 William street.

NEW YORK—Lexington Sales Co.; $10,000; dealer. M. J. Swetland, A. T. Smith, F. P. Foster, all of 239 W. 56th street.

NEW YORK—Mutual Motor Sales Co.; $25,000; dealers. Geo. Ozanne, 225 W. Englewood ave., Englewood, N. J.; W. P. Buchler, J. B. Kalmuk.

NEW YORK—New Denver Ford Starter Corp.; $20,000; manufacturer. J. R. Duff, 35 Broad street; M. L. Effinger, 1779 Broadway; J. T. McGovern.

NEW YORK—Overman Cushion Tire Co.; $150,000; to manufacture tires, rims and other automobile accessories. Max C. Overman, 250 West 54th street, New York City; C. A. Taussig, W. R. Lowther, 43 Cedar street.

NEW YORK—Radiator-Fix Co.; $10,000; manufacturer chemical solution for repairing automobile radiators. C. S. Galbraith, W. A. Harrison, L. H. Peck, Whitestone, N. Y.

NEW YORK—Reliable N. Y. & Brooklyn Auto Delivery Co.; $1,000; trucking. C. Cohen, 2011 Amsterdam avenue; L. B. Carhart, D. Katzman.

NEW YORK—Ridgewood Automobile Co.; $500; dealer. A. J. L. Knight, F. C. Kreuscher, R. S. Kreuscher, both of 2395 Silver street, Ridgewood, N. Y.

NEW YORK—Royal Electric Motor Co.; $9,000; dealer. Abr. Zwonitzky, 174 Kosciusko street, Brooklyn; Isaake Joffe, B. Schwartz.

NEW YORK—Spengler Automobile Co.; $10,000; dealer. Henry Spengler, 334 St. Nicholas avenue; Gustave Supper, E. E. Braendle.

NEW YORK—Terrace City Motor Car Co.; $25,000; dealer. R. S. Conant, 159 Warburton avenue, Yonkers; Woodruff Smith, H. B. Mook.

NEW YORK—Vitaspark Corp.; $10,000; ignition devices for automobiles. F. C. Schofield, Roderic Wellman, F. A. McGurk, all of 15 Wall street, New York City.

NEW YORK—130th Street Garage; $5,000. Mendick Johnson, Jr., Agnes Johnson, John Mortensen, all of 3242 Broadway.

New York

ITHACA—Cole Garage Co.; $12,000. W. W. Cole, John Hovanus, J. A. Sherwood.

BROOKLYN—Auto Storage Co.; $500. Henry Bender, Geo. Jung, D. J. Ennis, 394 East 2d street, Brooklyn.

BROOKLYN—Baker Electric Motor Service; $20,000; dealer. F. A. Jannicky, 906 Eastern Parkway, Brooklyn; Frederick Bowers, B. R. Shears.

BROOKLYN—Bergen Taxi Cab Co.; $1,500; taxicab business. H. Weingold, 844 Eastern Parkway, Brooklyn; Jas. Shapiro, M. Miller.

BROOKLYN—Brooklyn & Long Island Auto Associates; $20,000; dealer. A. J. Farrell, 1178 Bedford avenue; C. F. Batt, R. P. Lumley.

BROOKLYN—Dujardin Rubber Co; $100,000; tires, tubes, accessories. F. B. and F. B. Hutcheon, Henry Dujardin, 3303 Glenwood Road, Brooklyn.

BROOKLYN—Lewis-Dietz-Caldwell; $2,000; dealer. K. S. Caldwell, Rue De St. Delix, Far Rockaway, N. Y.; G. C. Dietz, G. W. Lewis.

BROOKLYN—Reid Ave. Garage & Machine Co.; $5,000. Abr. Goldfarb, 5 Beekman street, New York City; R. K. Allison., O. E. Weidlieb.

BUFFALO—Frick Auto Sales Corp.; $10,000; dealer. J. L. Frick, F. H. Pickett, C. R. Jackson.

HUDSON—Hudson City Taxicab Co.; $3,000; taxicab business. A. B. Miller, G. C. Miller, B. M. Mossman, all of Hudson

MINEOLA—Gibson and Domhan Co.; $1,000; dealer. R. M. Gibson, J. J. Domhan, Chas. Liebeck.

NEW ROCHELLE—Saxon-Tracy Co; $3,000; to manufacture motors, etc. Wm. Abramson, 825 Tinton avenue, New York City; D. Straus, L. Rothfeld.

POTSDAM—Island Garage; $5,000. L. B. Bartholomew, J. L. Dandy.

QUOQUE, L. I.—Dimond-Apperson Motor Co.; $15,000; dealer. J. R. Dimond, 171 W. 71st street; Thos. Dimond, A. C. Warren

ROCHESTER—Eastern Tire & Supply Co.; $5,000; manufacturer. J. G. Barclay, W. T. Kineaig, Arthur Smith, both of Rochester.

ROCHESTER—C. H. Washburne; $25,000; dealer. C. H. Washburne, E. P. Washburne, E. H. Lamb.

SYRACUSE—Resilient Steel Wheel Co.; $25,000; manufacturer. J. M. Grenan, 372 S. Salina street, Syracuse; C. Leonard, H. F. Leonard.

Ohio

AKRON—Portage Motor Sales Co.; $8,000; dealer. H. W. Petley, Henry Petley, H. M. Hagelbarger, G. K. Doolittle, E. M. English.

AKRON—Xylos Rubber Co.; $50,000, manufacturer. H. W. Pohlemus, M. S. McGregor, G. Sister, J. H. Focht, W. E. Davies.

CLEVELAND—Entz Starter Co.; $10,000; to manufacture starters and other accessories. J. T. Scott, D. L. Johnson, M. C. Byrnes, B. E. Robertson, M. G. McAleenam.

CLEVELAND—Lohse Automobile Improvement Co.; $25,000; manufacturer. Richard Ryder, W. G. Rauder, Matthew Reitz, Richard Lohse, K. C. Wehrmeyer.

COLUMBUS—Remington Auto Sales Co.; $10,000; dealer. C. H. Shira, Orrin Thacker, W. A. Jackson, W. E. Pearse, O. H. Mosler.

IRONTON—Ironton Garage Co.; $10,000; accessory dealer, etc. R. W. Rowland, I. L. Riley, T. N. Erskine, W. R. Edwards, A. C. Robinson.

Oklahoma

OKLAHOMA CITY—Paige Motor Car Co.; $8,000; dealer. J. T. Wheatly, W. H. Crane, J. L. Daniel, all of Oklahoma City.

TULSA—Jeffery Motor Sales Co.; $3,000; dealer. C. R. Adams, F. B. Adams, L. L. Giacomi.

Pennsylvania

PORTAGE—Portage Automobile and Machine Co.; $10,000; dealer. J. M. Stedart, J. F. Schofield, R. L. Houck, F. W. Eicher, O. W. Mitchell, all of Portage

Texas

DALLAS—McGraw Tire and Rubber Co.; $10,000; dealer. C. E. Pumphrey, R. E. L. Saner, S. L. Warner.

Utah

LOGAN—Kimball Auto Co.; $25,000; dealer. N. W. Kimball, W. R. Sloan, Roy Kimball, H. G. Hayball.

Virginia

NORFOLK—Dixie Motor Co.; $20,000; dealer. B. R. Wrenn, G. D. Taylor.

RICHMOND—Baker Electric Car Co.; $3,000; N. R. Elrich, P. B. Smithson.

RICHMOND—Harrisonburg Auto Transportation Co.; $50,000; motor bus business. A. M. Graves, H. M. Effinger.

RICMOND—Motor Air Pumping Sales Corp.; $25,000; manufacturing and dealing in air pumps. H. K. McHarg, Jr., president; O. B. Newton, secretary, both of Roanoke.

Washington

SEATTLE—Combs Automobile Tire Co.; $100,000; manufacturer. P. S. Combs, A. E. Combs, P. S. Combs, Jr.

SEATTLE—Manitou Motor Car Mfg. Co.; $2,000,000; manufacturer. R. O. Ring, H. B. Schenck, J. K. Schenck, F. E. James, 404 Joshua Green Rd., attorney.

Wisconsin

OSHKOSH—Paragon Oil & Supply Co.; $15,000. E. L. Thompson, T. F. Coffey, Eric Thompson.

Change in Capitalization

Ohio

CLEVELAND—Cleveland Motor Car Sales Co.; $25,000 to $50,000.

Wisconsin

RACINE—Standard Electric Works; $25,000 to $100,000.

Automobile Agencies Recently Established

PASSENGER CARS

Arizona

Mesa	Maxwell	E. D. Bayless
Phoenix	Dodge Bros.	McArthur Bros.
Tucson	Maxwell	Hankins & Martin
Tucson	Ford	Mansfield & Condron

California

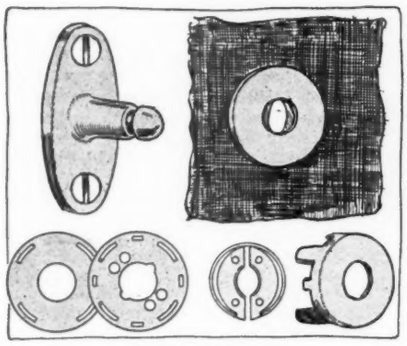
Brentwood	Oldsmobile	Brentwood Garage
Carmel	Oldsmobile	G. Schweninger
Los Angeles	Howard	L. C. Buxton
Los Angeles	Lexington	L. C. Buxton
Los Angeles	Moon	L. C. Buxton
Los Angeles	Mitchell	Wm. R. Ruess Co.
Oxnard	Oldsmobile	C. M. Penland
Pasadena	Stearns-Knight	A. L. Ryder
Pasadena	Mitchell	A. L. Ryder
Pasadena	Oldsmobile	W. J. McCulley
San Francisco	Jeffery	W. Milburn
San Francisco	Trumbull	C. S. Clancy
San Francisco	Chalmers	M. Bunnel
San Jose	Chandler	W. J. Benson
South California City	Jeffery	Carlton-Faulkner & Bowles

Colorado

Denver	Krit	Wm. Thorney Auto Co.
Denver	Walker Electric	E. M. Jackson
Denver	Dodge Bros.	T. Botterill
Denver	Briscoe	G. A. Estabrook
Denver	Monroe	H. E. Maines
Denver	Monarch	S. H. Klein
Denver	King	Mid-West Auto Sales Co
Denver	Grant	Mulnix & Steese

ACCESSORIES

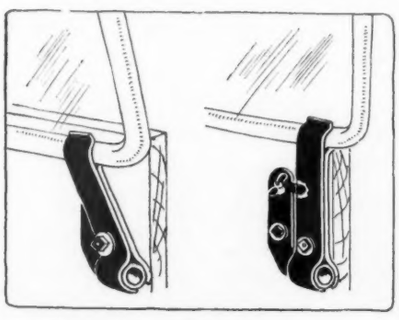
TOP FASTENERS—A clever invention is the Boston Push and Pull fastener for tops, automatic curtains or leather goods of any sort or kind. It consists of a vertical stem attached to one part and a ring clinched to the other. Just beneath the head of the post there is a groove and the extreme top is rounded off. The under side of the head (which is made almost



New top fastener

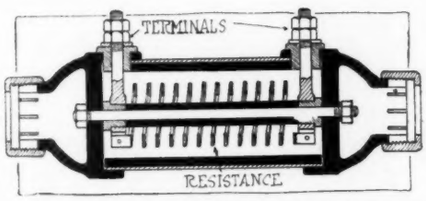
hemispherical by the rounding) has a sharp edge, but the lower edge of the groove is rounded off a little. The ring clinched to the curtain or other similar part is hollow and there is within it a second smaller ring that lies loosely and can shake about from side to side. This inner ring is made in two halves, each a very small amount less than a true half ring, and they are held together by a light spring action. The hole in the outer part of the ring is only just a close fit on the stem, and the two inner pieces are forced apart a little as the ring is pushed over the head of the post. Naturally when any attempt is made to remove the ring the half rings slip into the groove and prevent the ring from moving further, though the ring can be pushed past the groove when going on, owing to the rounded lower edge of the groove. The hemi-spherical head of the post is on a spring so that it can be pressed down by the finger so as to close the groove, whereupon the ring falls off easily.—Boston Fastener Co., New York City.

Ford Ventilator — This is an attachment for a Ford windshield which allows the whole shield to be drawn back a little, so opening a slot the whole width of the dashboard. It is of extremely simple construction and has a latch to secure it in the normal or closed position. To open it is only necessary to turn the latch and pull back the windshield. The fitting should be easy to attach to the car and sells for a remarkably low price.—L. P. Halladay Co., Streator, Ill.



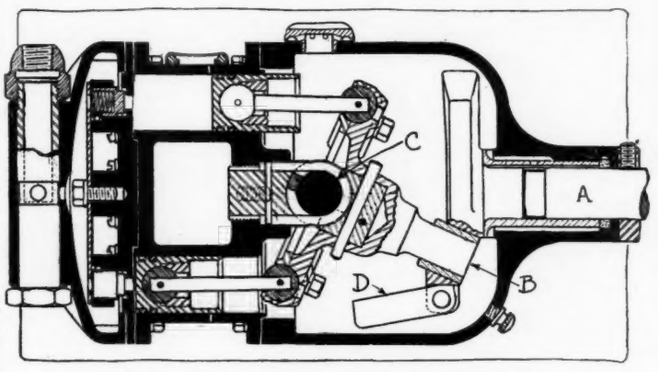
Ventilating windshield for Fords

Carbureter Air Heater—Nearly every starting difficulty with automobile motors is due to poor carburetion arising from the low temperature of the air and the fuel. It must not be forgotten that the vaporization of a liquid extracts heat from the gas or air in which the vaporization takes place, so that if we start with cold air it becomes still colder by the time it has taken up the gasoline spray. If the original air temperature is low enough the result of the chilling action of the gasoilne may easily result in the latter being thrown down in the manifold and cylinder in liquid form, and in such a case it is only the lighter fractions in the gasoline that mix with the air and give an ignitable gas. Often in actual fact it is the heat generated by the compression of air in the engine that causes the deposited gasoline to vaporize and this sometimes explains why a motor will start after repeated spinning following injection of raw fuel. Since the modern car has always plenty of electricity available it is a natural enough idea to utilize some of it for heating up the air to be used for starting purposes, and one of the neatest devices having this end in view is the Paul preheater, illustrated. This is a section through the apparatus which is intended to be inserted in the middle of the hot-air pipe of the carbureter; the split ends of the preheater in conjunction with the cap nuts enable it to be gripped on flexible pipe if desired, so attachment is easy. Inside the chamber there is a coil of flat metal strip having a fairly high resistance, and the ends of this strip are fixed to the two terminals shown. A wire is run from the cranking battery to one of these terminals, and the return wire passes through a switch which can conveniently be located in the cowl. To use the heater it should be switched on about half a minute before cranking and the carbureter primed in the usual way. As soon as the motor starts, the exhaust pipe heats up and there is no more need for the preheater, so it can then be switched off.—Fort Wayne Engineering & Mfg. Co., Fort Wayne, Ind.

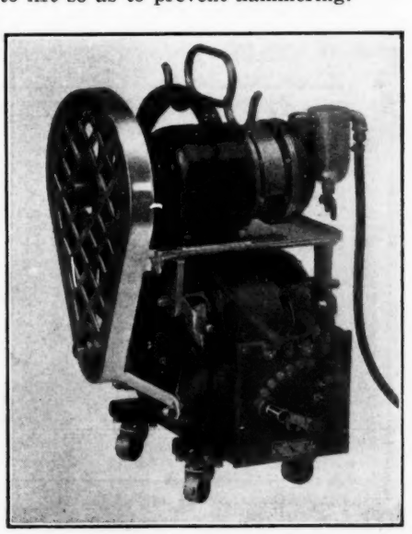


Carbureter air heater for easy starting. To be inserted in hot air pipe by means of the split ends and cap nuts

Garage Air Compressor—A very compact form of air compressor for tire inflation in garages is shown in this illustration. There are eight cylinders arranged in a block with their axes all parallel, and the corresponding eight pistons are driven by what is perhaps best described as a wabble gear. The shaft A is revolved and this causes the pin B to be carried round, also causing the plate attached to B to wabble or rock on the pin C. The little connecting rods have ball-and-socket ends so as to allow for the motion in two directions, and there is a dipper or blade D which splashes oil and spreads it over all the working parts. The cylinder bore is 1 inch and the stroke 1 5/16 in., giving a capacity of over 2 cubic feet of air per minute at the rated speed of 450 revolutons per minute. The air intake takes place through a stationary port and the outlet valves are brass, peened and not ground to their seats, and restrained as to lift so as to prevent hammering.



Section through Utility garage air compressor



Portable compressor with electric motor drive

The pump is said to be able to deliver air at 600 pounds per square in. pressure, if required, and is made of robust materials. It is supplied in form suitable for mounting, as a fixture supplying pipe lines laid in the garage, or it can be made up in portable form with an electric motor on a wheeled stand.—Utility Compressor Co., Detroit, Mich.

Jacks—Many types of lifting jacks for carrying on the car or for use in the garage are dealt with fully in the Eureka catalogue. Most of the portable type have a rapid action and either fixed or detachable handles. Special attention is drawn to the tire saving set of four jacks on which a car can be set up when putting it away for a long period.

Cored Bearing Bronze—A range of six graduated size bars of cored "Non-Gran" bronze are said to be sufficient to enable a repairer to turn up any of the fifty-four sizes of standard bushings and so cover the full range of automobile work, except for such bushings as exceed 1 1-4 in diameter. The range of bars is sold by the makers as one parcel at an inclusive price and the assortment is said to weigh about 21 pounds.—American Bronze Co., Berwyn, Pa.

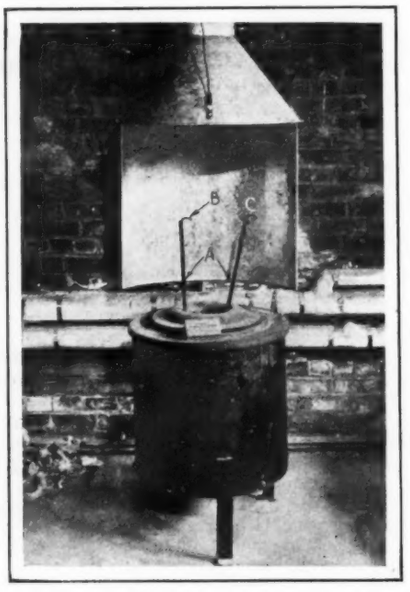
New Method of Gauging and Checking Furnace Temperatures, Inexpensive and Reliable

THERE is scarcely any process dealing with steel in the heated condition which does not call for an accurate degree of heat. Many alloy steels derive their special qualities solely from the heat treatment, which needs to be of very great accuracy indeed, and in drop forging it is possible to ruin an alloy steel part altogether by stamping it when a little too hot or not quite hot enough. The electric pyrometer has hitherto been the only practical instrument for determining temperatures and it has the two drawbacks that it is expensive to install and requires frequent attention if its accuracy is to be maintained. The essential part of a pyrometer is the thermo-couple which has to be located within the furnace, and this slowly deteriorates with long-continued high temperature and becomes less and less accurate till it has to be discarded eventually and replaced by a new part.

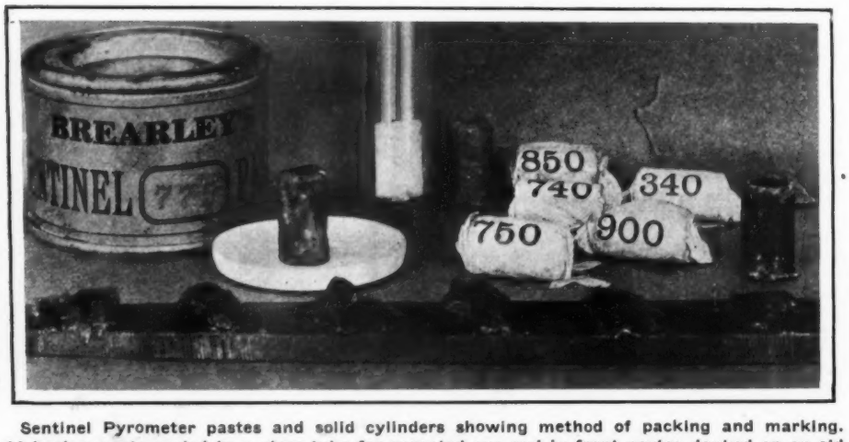
A much simpler method of gauging high temperature has recently been invented by Harry Brearley, who is one of the best known practical metallurgists in the world. Developed in Sheffield and found utterly satisfactory the idea is now being exploited in this country by the Carl Nehls Alloy Co., Detroit, Mich., who anticipate a very large demand.

The idea which is the basis of the system is simply that it is possible to find a salt that will melt at almost any desired temperature within a quite wide range. Thus if we have a salt which melts at 800 degrees Centigrade, and if we place some in a furnace and keep it under observation, we know that as soon as it commences to melt the temperature must be at least 800. Of course this only gives a check on one side, and if we do not want the temperature to rise above, say, 820 degrees we must have a second salt melting at that degree of heat. If we now arrange the firing so that the first salt remains molten and the second stays solid we know for certain that the temperature of the furnace is between 800 and 820 degrees Centigrade.

This extremely simple notion is not new, but has been used in the laboratory for a long time, so Mr. Brearley's work has been to choose a suitable series of salts to cover all the needs of the steel trade and to make them up in convenient forms.



Carbonizing furnace with cylinders of Sentinel salt in blind tubes A. Rods B and C rest on these cylinders and since B has dropped while C is still raised we know that temperature in furnace is between the melting points of the two Sentinels



Sentinel Pyrometer pastes and solid cylinders showing method of packing and marking. At back a paste sealed in a glass tube for repeated use and in front pastes daubed on an old file for testing regularity of temperature in a furnace

The name Sentinel Pyrometers has been chosen to describe these salt mixtures, and they are made up in two principal forms, either as solid cylinders 7/16 in. diameter and ¾ in. long or as pastes. The cylinders are packed in wrappers showing their melting temperature, and for use in places where the degree of heat is below the melting point of glass they can be sealed in tubes and used over and over again. Still, even if only used once, the cost is very small, since 100 cylinders are supplied for $5 packed in tin cases holding fifty cylinders each.

The second way in which the salts are put up is as pastes, and in this form they can be used to show the temperature of actual pieces of metal, such as steel bars being heated for drop forging. The salt is ground up finely and mixed with paraffin wax, in which condition it can be daubed on any part and the desired temperature has been reached as soon as the paste melts off. Sufficient paste to make several hundred tests is packed in cans and sold for $1.25, so its use is far from costly. The paste is a convenient form in which to use the salt to check the even heat of a furnace, since a bar of steel can have a series of daubs of paste put along it, and if one melts before another it shows that the heating of the bar is uneven, which knowledge could only be obtained with an electric pyrometer by the use of a series of thermo-couples, and these require careful and costly fitting to the furnace.

To check the temperature of a carbonizing furnace, which ought not to be opened or examined internally during the process, it might appear that the salt would be no use, since it would be out of sight. To overcome this trouble the ingenious idea has been hit upon of placing the salt cylinder at the bottom of a blind-ended tube which runs up to a visible spot outside the furnace, and then sliding a rod down the tube till its lower end rests on the Sentinel. When the latter melts, the rod of course falls, and by using two tubes, one with a cylinder that is to be kept melted and the other with a salt that ought not to melt, it is only necessary to watch the ends of the two rods. This arrangement is shown in the illustration.

While the Sentinel pyrometer cylinders and pastes will doubtless be of the greatest value to steel makers and to manufacturers using alloy steels, the pastes ought also to be very useful in repair shops where proper electric pyrometer installations would be impossibly costly for the small use to which they would be put.